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EBASCO SERVICES INCORPORATED
R.L. STOLLAR AND ASSOCIATES
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PREPARED FOR

PROGRAM MANAGER'S
OFFICE FOR
ROCKY MOUNTAIN ARSENAL CLEANUP

ROCKY MOUNTAIN ARSENAL

PROCEDURES MANUAL

TO THE

TECHNICAL PLAN

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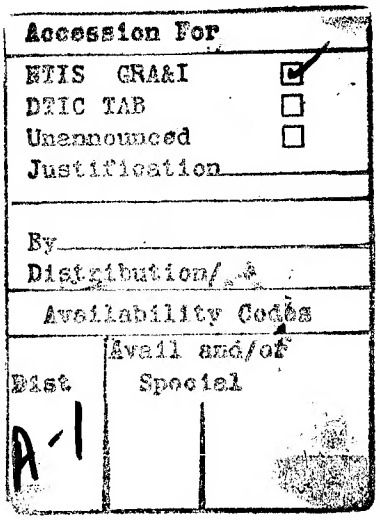

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SECTION I

TECHNICAL REQUIREMENTS FOR DRILLING, WELL CONSTRUCTION, AND AQUIFER TESTING

I.1 Soil Boring and Sampling

I.1.1 Introduction

The objectives of this phase of the work are to conduct soil boring and soil sampling operations so as to obtain appropriate samples consistent with the sampling program described above. The present section describes only the field techniques and procedures to be utilized in this effort.

I.1.2 Borehole Drilling Techniques

Hollow stem auger techniques will be used to drill in the alluvium and Denver Formation at Rocky Mountain Arsenal. As the boreholes are being drilled and as the samples are being obtained, a volatile organic analyzer (sniffer) will be used to determine the presence of volatile organics. This will be done for both safety and for data collection. These meters will be used to determine the level of respiratory protection required. The meters will be used as the hole is being drilled to determine if there are changes in volatiles emanating from the hole. In addition, each sample will be scanned to determine qualitative information related to organics.

The auger rig will be equipped with a coring device which will allow for the collection of a continuous relatively undisturbed sample. A core barrel located inside the hollow stem will contain tubes manufactured from clear polybutyrate material which will collect the core. The coring device will penetrate the formation in advance of the auger bit, therefore, the auger bit will not come into contact with the portion of the formation being sampled. This technique will minimize cross-contamination.

Control tubes of polybutyrate material will be retained and sent to the laboratory for chemical analysis to determine if these tubes may contribute significant concentrations of organic compounds to soil in contact with the tube. The type and concentrations of such compounds will be reported.

The need to sample specific depth intervals, the desire for simplicity in core logging, and laboratory requirements for sample collection necessitate the preparation of polybutyrate core tube prior to drilling. The team laboratories require a 1 ft section of core be removed from the core length, be sealed, and remain sealed during shipment to the laboratory. Therefore, 1 ft sections of polybutyrate will be pre-cut and placed in the core barrel in positions appropriate to the predetermined sampling intervals. Once the core barrel has been removed from the borehole and opened, these pre-cut sections will be removed, sealed with foil lined plastic caps, and transported to the support facility for shipment. Control samples of the caps will be retained for possible future chemical analysis. Upon arrival at the laboratory the sample will be subcored with a cork-borer apparatus to obtain a soil sample which has not been in contact with polybutyrate. This procedure will minimize potential compatibility problems of soils and polybutyrate and reduce the chance of organic compounds being contributed to the soil sample from the core tube.

The remaining polybutyrate core tube, not designated for sample collection, will be placed in the core barrel after being cut longitudinally. Such a longitudinal cut, providing a split core tube, will allow efficient sample logging without the need for extrusion of the core from the tube. These longitudinally cut core sections will be removed from the core barrel at the borehole, taped and capped to hold them shut, and examined by the rig geologist to adjust the depth of borehole construction if necessary. The taped core section will be transported to the support facility and in the sample logging trailer be opened, logged, additional samples removed if appropriate, retaped, and sent to the core storage area.

The procedures for drilling and continuous coring are as follows:

1. Set up rig at staked and cleared borehole location;

2. Record location, date, time and other pertinent information on boring log form;

3. Place polybutyrate core tubes cut to specification into core barrel;

4. Commence augering and coring while logging cuttings;

5. At each 5 ft increment the bore barrel will be removed from the borehole;

6. The core barrel will be opened an 12 inch sections for laboratory analysis will be capped with foil lined plastic caps and sealed with tape;

7. Core sections previously cut lengthwise will be taped and sealed with foil lined caps to prevent opening during transport to the support facility;

8. The polybutyrate liner sections will be marked with an arrow pointing to the top end, the boring number, and depth interval. A label giving the same information as well as the project name and number, the date, and the sampler's initials will be attached to the core;

9. For each additional 5 ft depth increment to be cored, clean polybutyrate liners will be placed in a clean core barrel;

10. The boring is considered complete when the predetermined depth is reached or the drilling encounters the water table, whichever comes first;

11. All core sections will be transported to the support facility for logging and sample shipment preparation;

12. The boring stake will be left in the ground adjacent to the borehole and a board placed over the hole until it has been grouted;

13. The borehole will be grouted the same day of construction and the borehole location stake be placed in the grout;

14. Upon completion of each boring, the augers and other downhole equipment will be decontaminated in the field prior to moving to the next borehole location;

15. Enough augers and core barrels will be available such tha one set may be in use while a second set is being decontaminated;

16. At the end of the working day all equipment and personnel will proceed to the decontamination pad where decontamination procedures will be initiated. Decontamination procedures are described in Section 7.0.

17. All boring cuttings will be drummed and stored awaiting USATHAMA direction for disposal.

A hydrogeologist will be responsible for each operating rig. A comprehensive procedural document for well drilling and construction which covers the collection of subsurface samples and preparation of lithologic, well construction, and work logs will be followed. These procedures are described below, with supplemental information given in Section 7 of the QA/QC Plan.

The site hydrogeologist will be responsible for supervising the operations of the drilling rig and logging the soil and/or rock samples. Detailed soil and lithologic logs will be kept by the hydrogeologist. Soil samples will be classified using the Unified Soil Classification System (Technical Memorandum No. 3-357, April 1960, U.S. Army Engineer Waterways Experiment Station). The following parameters will be used in the soil descriptions:

CLASSIFICATION
UNIFIED SOIL CLASSIFICATION SYMBOL
SECONDARY COMPONENTS WITH ESTIMATED PERCENTAGE
MUNSELL COLOR
PLASTICITY
CONSISTENCY OR DENSITY

MOISTURE CONTENT
TEXTURE/FABRIC/BEDDING
DEPOSITIONAL ENVIRONMENT

The hydrogeolist will store soil samples in glass jars which will be sealed with Teflon lined lids. Some unused glass jars will be retained for possible future chemical analysis. Each sample will be tagged with a label containing the following information:

PROJECT CODE/NUMBER
PROJECT NAME
DATE OF SAMPLE
TIME OF SAMPLE
BORING NUMBER
SAMPLE NUMBER
SAMPLING INTERVAL
FIELD OBSERVATIONS
REMARKS
INITIALS OF HYDROGEOLOGIST

The samples will be stored in core boxes and retained at Rocky Mountain Arsenal at an area designated by the Army. This area has been tentatively identified as Building 728, in the South Plants Area. The samples will be submitted to USATHAMA at the completion of the project. The original lithologic logs will be submitted directly from the field to the USATHAMA project engineer within three working days after the boring is completed.

I.1.3 Sample Handling

Sample Containers - Soil samples will be collected in widemouth amber glass bottles fitted with Teflon lined lids. The bottles and lids will be cleaned, prepared, and provided by UBTL in accordance with the specifications detailed for amber glass bottles and liners (used for water sampling). Each sample will be appropriately divided and aliquoted for the required analyses upon receipt at UBTL. Sample containers will be marked with sampling date, time, and location at the time of sample collection.

Sample containers identical to those used for field samples will also be provided for requisite field quality assurance (QA) samples.

Sample Preservation - The quality of analytical data derived from samples is critically dependent upon sample integrity. Accordingly, efforts addressing the preservation of sample integrity, initiated at the time of sampling, will be continued until all analyses are completed.

Because the soils samples are to be analyzed for organic compounds (e.g, compounds comprising the base/neutral fraction and the pesticide/PCB fraction of EPA Method 625), samples will be cooled to a minimum of 4°C immediately after collection and maintained at this minimum temperature until analytical procedures are initiated. No other preservation procedures are required. Extractions will be completed with seven days of sampling and all analyses including the analysis of extracts will be completed within 30 days of sampling in accordance with the specifications of the USATHAMA Quality Assurance Program Document and the Project QA/QC Plan.

Shipping - The samples will be placed in insulated shipping containers (supplied by UBTL) ice packs to maintain sample temperatures below 4°C until the samples arrive at the laboratory. Samples will be shipped to the laboratory (UBTL) on the same day of sample collection via priority (same-day) service carriers (for example, Federal Express or Emery).

I.2 Monitoring Well Construction Methods

The monitoring wells will be installed during Phase II, after the soil boring activity and evaluation of Phase I analytical data. At this time much soil and chemistry data will be available to determine the location for the wells.

At the completion of soil sampling, a ten-inch auger bit will be used to ream out the hole in order to have a greater diameter of annular space with the hollow stem to construct the well. The wells will be screened in the alluvium or in the first sand of the Denver Formation.

Four-inch diameter flush threaded Schedule 40 polyvinyl chloride will be used as the casing material in all monitoring wells. All casing materials will be steam cleaned prior to being lowered into the hole. No glue, solvents, and/or cleaners will be used.

Four-inch diameter flush threaded Schedule 40 polyvinyl chloride will be used as the well screen material in all monitoring wells. The well screens will be factory slotted and the slot size will be .030 inch subject to approval by USATHAMA. We have determined that this slot size will be the most efficient, given the types of alluvial deposits typically found in the RMA area. The depth to screen and length of screened interval will be determined by the field hydrogeologist upon completion of the drilling. However, the material screened will either be the alluvium or the first sand in the Denver Formation. The casing and screen will be lowered in to the borehole through the annular space. At this time the well will be gravel packed.

Gravel pack material installed in the annulus between casing and borehole will be approved by the Contracting Officer, according to Section 7.4.2 of the QA/QC Plan. The gravel pack will be set to a level of 2 to 5 feet above the screen, as monitored by periodic measurements with a weighted tape.

A bentonite pellet seal will be installed in the annulus above the gravel pack to a minimum thickness of 5 feet, as monitored by periodic measurements with a weighted tape. This thickness may be less than 5 feet, if the water table is shallow (less than 10 feet). Bentonite pellets will be approved by the Contracting Officer, in accordance with Section 7.2.1 of the QA/QC Plan.

Grout composed of a cement/bentonite slurry will be pumped in the annulus (circulated from the bottom upward) above the bentonite seal to land surface. As the grout is being pumped in, the auger is pulled back and out of the borehole. After a 24-hour waiting period, more grout will be added if settlement has occurred. Grouting will be completed as specified in Section 7.2.4 of the QA/QC Plan.

A steel protector pipe (6-inch diameter, 5-foot length) with a hinged cap and lock will be placed over the 4-inch diameter PVC well casing within 24 hours

of initial grout placement. Protection pipe specification and installation procedures stated in Section 7.4.3 of the QA/QC Plan will be followed.

Well completion features will include painting the protector casing with safety-orange paint and installing four protector posts, a gravel pad, an internal mortal collar, and a drain/vent hole. Well completion piping will be installed according to Section 7.4.3 of the QA/QC Plan. Upon well or boring completion, all work areas around the well/boring site will be restored to their equivalent pre-installation physical condition, as specified in Section 7.2.13 of the QA/QC Plan. It is assumed that USATHAMA will be responsible for disposal of residual drilling fluids, cuttings, and other materials contaminated as a result of drilling in contaminated areas. At the direction of USATHAMA, these materials will be drummed and stored near the site where generated. The types of forms to be used in recording well completion data will be forwarded to USATHAMA at their request.

Time requirements for well completion with specified intervals of boring completion are stated in Section 7.4.1 of the QA/QC Plan. This section also states that well construction work will not be interrupted by darkness. The Ebasco team will attempt to satisfy these requirements to the extent pratical, with the realization that field conditions, safety, and overtime costs will be factors in the program. The scope of work and cost estimates provided in this proposal for the RMA do not take into account around-the-clock working hours.

Records of well construction will include materials specifications and amounts, completed well dimensions, and a well construction diagram. Specific requirements will be followed as stated in Section 7.5 of the QA/QC Plan.

Well development is performed on the completed monitoring wells to clean residual drilling fluids out of one well and assure good hydraulic connection between the well and surrounding formation. Development will be started sooner than 48 hours after mortar collar placement, and will be accomplished by means of pumps and/or bailers. A minimum of five times the volume of standing water in the well sand pack and annulus will be removed. Periodic

pH and conductivity measurements of the well discharge will be taken during development, and detailed records of the development process will be maintained. Requirements for well development stated in Section 7.6 of the QA/QC Plan will be satisfied.

I.3 Abandonment of Boreholes

All boreholes not used for well construction will be abandoned according to Section 7.2.5 of the QA/QC Plan. Borehole/corehole abandonment plans will be approved by the Contracting Officer prior to execution. The holes will be sealed by implacement of an appropriate bentonite/cement slurry (Section 7.2.4, QA/QC Plan) circulated from the bottom upward to land surface. Settled slurry will be supplemented after a 24-hour waiting period. Borehole abandonment will be carried out according to Section 7.2.5 of the QA/QC Plan.

At the direction of USATHAMA, water discharged during development will be collected in 55-gallon drums. It is assumed that USATHAMA will be responsible for disposal of contaminated fluids removed from wells during development.

32.4 Water-Level Measurements

Water levels will be measured in monitoring wells during and after drilling, before and after development, and before and after sampling. Continuous water-level recorders may be placed on selected wells to provide plots of depth to water versus time over daily or weekly periods. Water levels will be measured with a steel tape and chalk to the nearest 0.01 foot, or an electric line to the nearest 0.01 foot.

I.5 Aquifer Tests

Test methods for determining hydraulic conductivity with a single well will be carried out. These tests are called slug tests. The test usually involves injecting a cylinder or removing a slug of water instantaneously from a well and measuring the recovery of water in the well. The method was first developed by Hvorslev (1951). Because of the rapid water level

response in coarse materials, the tests are generally limited to zones with a transmissivity of less than about 70 cm^2/sec (Lohman, 1972). The method has been extended to allow testing of extremely tight formations by Bredehoeft and Papadopulas (1980). Bouwer and Rice (1976) developed a method for analyzing slug tests for both confined and unconfined aquifers.

To undertake Bouwer's Slug Test, the monitoring wells planned for this project will be used. The well-construction material is not critical. The well to be tested may be completed as a naturally developed or gravel packed well, depending on the nature of the formation. Development can be by pumping, surging, swabbing, etc., depending on site conditions and project constraints.

Following completion, a sealed cylinder (a dummy, if you will), slightly smaller diameter than the well diameter, is dropped very quickly into the well, displacing the fluid in the well upward and outward. The cylinder can be made of material similar to the casing and screen. Low-cost materials like PVC are useful if cylinders are "dedicated" to each well. The cylinder can be as short as 2 to 3 feet or as long as the height of the water column above the well bottom. A longer cylinder displaces more water and produces more reliable results, but ease of handling is a consideration, too.

Data are collected at timed intervals, beginning when the cylinder enters the fluid. The water-level rise and subsequent decline is measured until the water level stabilizes (generally 10 to 20 minutes). Water levels will be measured using downhole pressure transducers. The transducer, as well as all other downhole instruments, will be pressure washed with water prior to use in the well. The transducer is placed in the well below the water level and the other instruments (volt meter and battery) are attached. Because the measurements are in millivolts, the transducer is calibrated by changing its depth by a known amount and measuring the corresponding change in voltage. The transducer is then lowered into the well to a depth which will allow placement of the slug, and the water level will be monitored. Once the water level stabilizes the slug is dropped to a predetermined depth and secured. The voltage and time will be recorded when the slug is dropped and at specific times afterward until stabilization and again when the slug is

removed from the well. The test will be completed when the water levels appear to stabilize which is typically less than one hour.

The main advantage to using the slug test method is that no water is removed from the well. This eliminates the problem of disposing of the potentially contaminated well water. In addition, because the length of the test is short it can be run several times at each well, if necessary, to ensure accurate results. Following stabilization, the cylinder is removed, and the water-level decline and subsequent rise is measured at timed intervals until stabilization again occurs.

Data are interpreted by comparing solutions to available empirical equations and graphs previously developed from electric analog modeling of the various well, formation, and testing parameters. Data collected during the second phase (after removing the cylinder) have been most consistent, although data collected during the first phase provide a reasonable check.

The permeabilities generated primarily reflect the value within a few feet of the screen zone in a horizontal direction. Thus, the permeability of specific zones or the aquifer as a whole can be controlled by selecting the screen length. Reliable results have been obtained in formations ranging in permeabilities from less than 0.1 gpd/ft (gallons per day per foot) to more than 100 gpd/ft.

The test method has been used in a number of environments successfully including:

- o fine grained material at RMA;
- o silty sand and weathered bedrock of the Piedmont;
- o a water-table aquifer overlying a confined leaky artesian aquifer in the Coastal Plain; and
- o a shallow water table in an uplands/wetlands complex.

Given data about geologic conditions outside the well screen intervals, data manipulation techniques like weighted averages, multi-linear regression analysis, and Kriging are available to estimate permeabilities at other depths and locations.

I.6 Ground-Water Sampling Procedures

I.6.1 Sampling Program

The sampling program will commence upon COR approval of the analytical method certification data submitted by the chemical laboratory and no earlier than 14 days after well development has been completed for the new monitoring wells.

Depth to water will be measured in each monitor well, immediately prior to sampling, and the volume of standing water in the well plus the saturated annulus will be calculated and recorded. Five times this volume will be removed before obtaining the water sample. We have developed alternative sampling procedures, approved by USATHAMA's Systems Engineering division, to be used in the event that five well volumes are neither practical or feasible. Such instances may occur, for example, in a well which is repeatedly pumped or bailed dry before five well volumes are removed and well recovery is slow due to low transmissivity conditions. In such cases, specific procedures, dependent upon recovery times, will be presented to the COR for each well.

To protect the wells from cross contamination during sampling procedures, stainless steel bottom filling bailers with teflon ball valves will be dedicated to each well. The line to lower and raise the bailer will consist of monofilament nylon. An unused roll of monofilament nylon line will be retained for possible future use as a control sample. Before and after sampling the well, the bailer will be cleaned by rinsing with a solvent (acetone), a detergent and then unchlorinated water for which chemical analyses are available. This bailer will remain in place in the well during the monitoring phases.

All sampling equipment will be placed on disposable polyethylene plastic sheeting spread on the ground at the well to prevent soil contamination from tainting the ground water samples. An unused length of plastic sheeting will be retained for possible future use as control sample.

Samples will be collected in the appropriate amber glass bottles with Teflon lined lids for organic analyses, and linear polyethylene bottles for inorganic analyses. Preservatives will be added as necessary. Samples for dissolved metals will be filtered in the field using a 0.45-micron filter and will be preserved in accordance with the USATHAMA QA Plan and the project QA/QC plan. Samples for volatile organics analyses will be collected in screw cap, Teflon septum top, amber glass, 40-ml. vials. All containers for sample collection will be cleaned, rinsed, packaged, and labeled at the laboratory and delivered along with preservatives to the site. Samples will be collected using appropriate procedures and kept at 4°C until analyzed.

All sampling equipment will be thoroughly cleaned and rinsed with distilled water prior to use in each well. Water evacuated from wells and water used in cleaning will be discharged on the ground as directed by USATHAMA in areas that are remote and where there will not be any ponding or runoff. In areas that are not remote or where conditions will cause ponding or runoff, water will be discharged into a waste-water storage tank or container. Waste water will be disposed of upon direction from USATHAMA and the COR.

Field conditions (weather, precipitation, and air temperature during and for three days prior to sample collection), ground-water levels, time and date, sampling techniques, and names of personnel will be entered on the data collection sheet and in a field notebook. Water quality parameters measured in the field also will be noted.

I.6.2 Methodology for Field Chemical Analyses

The following field procedures are taken from "Field Methods in Contaminant Hydrogeology," April 1981; Dept. of Earth Sciences, University of Waterloo, Waterloo, Ontario, Canada.

This section deals with chemical properties of ground-water that are difficult to preserve during storage and therefore must be measured in the field.

pH Measurements

A field measured pH is probably the most important geochemical property made on a ground-water sample; therefore, it is mandatory that it be made with care and patience. Without proper knowledge of the operation and maintenance of pH meters and electrodes and the endless possible problems that can arise during a measurement, an inexperienced sampler can easily become frustrated and settle for some arbitrary technique devised by himself or his organization to obtain a "reproducible" measurement.

1. Try to keep the operation out of direct sunlight.

2. Connect tubing from piezometer to flow-through box. Activate pump at low speed.

3. Place buffers, distilled water, and electrodes (up to the filling hole) in the spillover reservoir of the flow-through box.

4. Allow 10 to 15 minutes for temperature equilibration. To speed up the temperature equilibration process, one can transport the buffers and electrodes into the field in a camper-type cooler with ice packs.

5. Measure temperature of water in the flow-through box and check one buffer to ensure thermal equilibration and set the temperature compensator of the pH meter to this value.

6. Look up corresponding buffer pH's of the 7 and 4 buffer for the ground-water temperature if they bracket the pH of your sample water; or the 7 and 10, otherwise. Immerse the pH electrode into the seven buffer and adjust the "calibrate" knob to read the appropriate value (e.g., 7.06 at 10°C). This knob is a scale slider. Adjustments made here will adjust readings at other pH's by the same amount.

7. Remove electrode, rinse and place in the 4 buffer (4.01 at 10°C) allowing ample time for equilibration.

8. After equilibration, if the meter does not read the appropriate pH, adjust the temperature compensator so that it does. The temperature compensator is a scale expander and has no effect on a pH 7 but expands more and more the further the pH is from 7. Thus adjustments made there should have no effect on the 7 buffer reading. The purpose of the knob is to compensate for the non-Nernstian response of the electrode.

9. Check pH 7 buffer again to ensure proper calibration of the electrode system. If the pH does not return to within 0.02 units of the appropriate value, repeat calibration procedure.

10. Rinse the electrode thoroughly and insert into one of the electrode holes in the flow-through box and allow ample time for equilibration. Water should be maintained at low flow rate during the measurement.

11. After a stable pH reading is achieved, check back to the buffers. If they agree within 0.02 units, record the pH. Reproducibility in the field of at least 0.05 pH units should be strived for.

Eh Measurements

Due to the concept of Eh and the nature of the Eh electrode, operational field procedures for Eh measurements are quite different from those for pH measurements. The sensing device for the Eh electrode is usually a platinum billet or wire. The platinum, which must be kept unoxidized by regular polishing with emery paper or jeweler's cloth, acts as a site for the exchange of electrons to or from oxidation-reduction responsive species in solution. The procedure for a proper Eh measurement is decribed below.

1. Immerse bottle containing Zobell solution and Eh electrode in the spillover chamber of the flow cell.

2. Allow 10-15 minutes for temperature equilibration. Again, as for pH measurement, a portable cooler with ice pack will cut down the time for this step.

3. Measure the absolute mV reading of Zobell solution and check against the reported value at the temperature of interest after determining whether your electrode has a calomel or silver chloride reference cell. Note: if the value is substantially different (10-20mV), electrode polishing or cleaning procedures may be necessary. If the measured value still differs from the reported value even after polishing or cleaning then the investigator has the option of using the relative mV scale of the Ph meter where he may adjust the reading to that of Zobell. Since the platinum electrode is so simple in design, it should record the true mV reading of Zobell and it is recommended that the relative mV scale not be used.

4. After stabilization is achieved in Zobell and the reading is within 20 mV, rinse thoroughly and insert the electrode through one of the electrode holes in the flow cell. A low cell is essential for a reproducible field Eh measurement since diffusion of oxygen into the sample can produce substantial drift in the electrode response and ultimate stabilization on the Pt - PtO potential curve.

5. Record the mV reading of the water after 1, 2, 3, 5, and 10 minutes equilibration time. This information may be of value later when interpreting results from various ground waters from the same area.

6. If after 15 minutes the electrode has not stabilized, abandon the effort and record the reading and the rate of drift (mV/min).

7. Check Eh of the Zobell solution. If the reading is not within 10-20 mV of Zobell, it is suggestive that the platinum surface has reacted in some way with the solution, such as the formation of Pt - sulfide or Pt - hydroxide surface complexes or precipitates. Other than cleaning the electrode surface for the next sample, no recommendations can be made if this situation is encountered.

Procedure for Eh and Ph Measurements on Bailed Samples

For this program, ground water samples will be obtained using a stainless steel and teflon bailer. In some respects, bailing may be preferable to

pumping a well because of the CO_2 degassing effect often noted during pumping. If carbonate precipitation does not occur, degassing will produce an upward drift in pH. The following procedure is recommended.

1. Immerse buffers, pH and Eh combination electrodes and Zobell solution in a small container filled with bailed water from the piezometer or well.

2. Periodically add new bailed water over at least a 15-minute interval and continue until the water temperature has stabilized.

3. Perform calibration procedures on pH electrode and meter as outlined previously.

4. Immerse pH electrode in a small beaker and allow to equilibrate while continuously replenishing the water with fresh bailed water. Record the pH 1 minute after each time the beaker is refilled. Continue until a stable reading is attained.

5. Check back to buffer pH's Note: The water bath for the buffers and electrodes should also have been replenished during the Ph measurements.

6. Connect the Eh electrode to the pH meter and immerse in Zobell.

7. Check that the probe correctly reads the appropriate mV value for Zobell at the temperature of the water.

8. Rinse well and immerse electrode into the beaker used for pH measurements.

9. Repeat the recording procedure used for the pH measurements while replenishing the beaker with bailed water for a maximum of ten times or until the reading has stabilized. Record final reading and the rate of drift in mV/min.

10. Check the Eh of the Zobell solution.

Electrical Conductance

A simply measured and useful property of natural waters is its electrical conductance. Conductivity is proportional to the quantity of dissolved ions present in a water and can be used effectively in delineating pollution plumes, monitoring reaction progress, or just simply giving a rough idea of the total dissolved solids in a water sample.

Conductivity can be determined by placing a conductivity probe into a water sample and registering conductance on an appropriate meter while a direct current is applied at a known voltage between two electrodes (generally separated plates or rods) in the probe.

Conductivity meters and probes are commercially available from many major scientific equipment companies. Probes are manufactured to have a particular cell constant and commonly range from a value of 0.1 to 20. A cell constant is simply the factor one must multiply the meter reading by in order to obtain the true electrical conductance and is determined by measuring the conductance of 0.01 m KCl solution (cell constant = actual conductance measurement of 0.01 m KCl at 25° divided by measured conductance).

Since tolerances are allowed in the probe specifications during manufacturing, it is necessary to calibrate a probe in a solution of known conductance. Generally a 0.01 molal (m) KCl solution, which has an electrical conductance of 1400 mhos/km at 25°C, is used for this purpose. Manufacturer's specified cell constants can be up to 10% off the actual value. In addition, since meters also show variations in conductivity readings using the same probe, a probe must be calibrated for each meter with which it is being used.

Electrical conductivity varies markedly with temperature, exhibiting a 1-3% increase for every one degree centrigrade rise in temperature, depending on the solution composition. For comparison purposes measurements are generally standardized to the conductance of the water at 25°C. Since this is impractical or impossible in the field, a temperature compensator knob is supplied on nearly all conductivity bridges. The compensator, when set to

the temperature of the water sample, adjusts the reading by 2% per °C to what would be expected at 25°C. Since this adjustment is made electronically it cannot be expected to record the actual conductivity of the water sample if equilibrated to 25°C and thus is an approximation.

The actual measurement is made by inserting the probe in the sample and depending on the design of the meter selecting the appropriate range, adjusting the temperature compensator to the temperature of the water sample, and recording the reading.

SECTION II - GEOPHYSICAL PROCEDURES

GEOPHYSICAL PROCEDURES

Introduction

A geophysical test program was conducted at the RMA from November 12 to 14, 1984, in order to determine the effectiveness of geophysical methods in locating buried, unexploded ordnance (UXO), buried metallic objects and underground utilities at the RMA. The tests indicated that two geophysical instruments are able to detect these objects if the objects are larger than a certain minimum size or shallower than a certain minimum depth. These instruments are the magnetometer gradiometer and the pulse induction metal detector.

Magnetometer Gradiometer

A magnetometer measures the intensity of the earth's magnetic field. The magnetometer gradiometer measures the difference in magnetic intensity between two points, one of which is directly above the other and separated from it by one to three feet. Changes in the differential intensity can be caused by the presence of ferrous (magnetic) metal which can be UXO's (grenade, artillery shells, etc.), steel containers, or buried magnetic iron or steel utilities. Magnetic response is proportional to the mass of the ferrous metal target and inversely proportional to the cube of the distance to the target.

The magnetometer gradiometer is carried along a straight line crossing the area to be drilled and its readings are continuously recorded. When that line is completed, the gradiometer is moved along adjacent parallel lines until the entire area has been surveyed. The distance between parallel lines depends on the size and depth of the objects being sought. The readings are plotted on a map of the area, which then can be interpreted for buried objects.

The results of the test program at the RMA indicate that the magnetometer gradiometer is capable of detecting a small grenade at a depth of 2.5 feet and a 155 millimeter artillery shell at a depth of 5 feet. It can detect a steel drum at a depth of 4.5 feet. It is assumed that the gradiometer can detect steel pipes at normal depths of burial, but depending on the diameter and wall thickness of the pipes.

Pulse Induction Metal Detector

A pulse induction metal detector transmits pulses of electromagnetic energy into the ground. This energy induces currents to flow in buried metallic objects. The currents, in turn, radiate their own electromagnetic energy, which is then detected by a receiver element in the metal detector. Whether a metal object can be detected depends on the size of the object, its depth of burial, and electrical properties of the ground in which it is buried.

In similar fashion to the magnetometer gradiometer, the pulse induction metal detector is carried along a grid previously surveyed over the area to be drilled and its readings continuously recorded. The results are plotted on map of the drill site and visually interpreted, along with the gradiometer results. The two together will show a buried object if it is made of ferrous metal. If it is made instead of aluminum or brass or other non-ferrous metal, it will be indicated only by the metal detector.

At the RMA, tests indicated that the metal detector could locate a grenade buried at 2.5 feet and a 155 millimeter artillery shell buried at 2.5 and 5 feet. It should be able to detect buried utilities if they are made of metal and buried at depths of not greater than about 5 feet.

Test Results

Geophysical methods may, in some situations, fail to detect buried metal objects. They cannot detect buried objects made of non-metallic substances, such as wood, clay or concrete.

To provide a better understanding of the capabilities and limitations of geophysical methods, the results of the geophysical contractor's tests are given here.

The test program consisted of surveys at known and unknown areas. The known areas consisted of material buried during this test as either discrete items in pits or bulk burial in trenches. The unknown site was an area where material was known to have been buried in the past, but the specific nature of the burial and the quantity of material was unknown. Test area locations were chosen in part on the basis of soil composition to evaluate the effect of the soil clay content on the techniques.

Test Area 1 was located in Section 36 in an open field southwest of the intersection of 8th Avenue and E Street. Soils at this location are classified as a Platner Series clay loam. Test Area 2 was situated in the southeast corner of Section 26 in an open field northwest of the intersection of 8th Avenue and D Street. Soils at this location are Ascalon Series sandy loams. Both Test Areas 1 and 2 were used as known sites with material buried in trenches or pits constructed for this test program. Test Area 3, the unknown site, was in the southwest quarter of the northeast quarter of Section 36. The soil at this location would be predominantly classified as Platner Series clay loam.

Two trenches were dug in each of Test Areas 1 and 2 (for a total 4 trenches), and various metallic objects were buried both vertically and horizontally at measured depths. Test Area 2 also had seven separate pits dug for grenade and artillery shell burial. A series of wooden stakes marked the location of each pit after burial. A set of grid lines was established approximately five feet apart and oriented both north-south and east-west over each trench.

Two trenches were constructed at Test Area 1. Trench 1 was 60 feet long and 5 feet deep. Representative samples of ordnance were placed in the bottom of the trench and their position and depth were recorded. Ordnance included a white phosphorus grenade, bomb bursters, 105 mm shell, aluminum rocket casing, 155 mm shell, rocket motor housing, and a 55 gallon drum. All ordnance samples were laid flat in the first 30 feet of the trench and

duplicate ordnance were oriented vertically in the remaining 30 feet of the trench. Trench 2 was 20 feet long, 4 feet wide, and continuously varied in depth from 2 to 10 feet. Four 155 mm shells were placed at depths of 2, 4, 7.3 and 10 feet. Target sizes were kept constant to examine penetrations of geophysical methods.

Two trenches were also dug at Test Area 2 and the same suite of objects were buried in the same order as at Test Area 1. In addition, seven test pits were constructed primarily to determine size and depth detection limits for the three magnetometers (fluxgate gradiometer, fluxgate magnetometer, proton magnetometer). Three of seven test pits contained grenades buried 2.5, 5.0, and 7.5 feet deep; four of the pits contained 155 mm shells buried at 2.5, 5.0, 7.5 and 10 feet.

Techniques

A magnetometer measures the intensity of the earth's magnetic field. The Technos magnetometer is a gradiometer consisting of a nulled pair of magnetometers which detect changes in a null field. The changes in the null field are caused by small quantities of ferrous metal which can be UXO's (grenade, artillery shell, etc.). Magnetic response is proportional to the mass of the ferrous target and inversely proportional to the cube of the distance to the target.

The advantage of a gradiometer over a total field magnetometer is that correction for diurnal variations in the earth's field are not necessary (hence no base station is required). Another advantage is that surveys can be made in close proximity to fences, pipelines and buildings without impairing the detection capabilities. Finally, the data output from the gradiometer system can be continuously recorded, resulting in high resolution (more complete coverage) and rapid survey time.

Because non-ferrous metal in the form of aluminum rocket bodies and pot metal cannister UXO's was expected to be present, a metal detector was also tested. The metal detection response is proportional to the surface area of the metal target and inversely proportional to the distance from the target

to the 6th power. Because of this, the detection capability of the metal detector is limited to shallower targets than the magnetometer.

The fluxgate gradiometer magnetometer with a sensitivity of one gamma per foot was coupled to a continuous strip chart recorder, was calibrated, and then run along the established grid lines to test its ability to define the outlines of the trench or pit as well as the relative quantity of buried material. The magnetometer was held at different fixed distances above the ground surface during subsequent runs to test the equipments' sensitivity to the targets. Continuous measurements were made along the grid alignment, and the burial locations (stakes) or grid intersections were marked on the chart paper. This continuous coverage is much more suitable for high resolution requirements, and the mapping of extensive areas in which complex anomalies are expected. In the area of the separate burial pits, magnetometer runs were made over and to either side of the alignment of the pits. Once the magnetometer survey was completed, the Technos pulse induction metal detector was calibrated, coupled to the chart recorder and run directly over the alignment of the trench or pits to judge its capabilities.

Results

Magnetometer Survey. The results of the magnetometer survey indicate that the fluxgate gradiometer magnetometer is capable of detecting a small hand grenade at a depth of 2.5 feet and a 155mm artillery shell at a depth of five feet.

The magnetometer responded to the two 55-gallon drums in Test Area 1 - Trench 1, buried 4.5 feet (lying flat) and 2.7 feet (upright). Because the response from the drums is so strong and is detected from a distance as far as 5 feet from the drums, any possible response from the other ferrous objects has been masked.

The magnetometer is also capable of detecting discrete, buried 155 mm artillery shells as deep as 4 feet below the surface at a horizontal distance from the shell of approximately 3 feet. The magnetometer may have received signals from the shell in Test Area 2 - Trench 2 buried 5.3 feet

below the land surface, but it is possible that its response is masked by the other signals.

At Test Area 3 (the "unknown" area), a surface-exposed steel barrel transmitted a strong response to the magnetometer during the survey run as would be expected. However, the magnetometer response also indicated that a significant amount of material is buried in this trench. Also, very little material appears to be within the adjacent berm.

At Test Area 2, identically sized UXO (155 mm shells) were buried at various depths in several burial pits. The Technos magnetometer was capable of locating an artillery shell at a depth of 5 feet. Harding Lawson Associates' (HLA) fluxgate magnetometers and proton magnetometers were able to detect only the 155 mm shell buried at 2.5 feet. The effects of the shell buried at 2.5 feet can be seen within 15 feet of the object.

Metal Detection Survey. The Technos pulse induction metal detection survey detected buried UXO as large as a 155mm artillery shell at a depth of five feet and as small as a hand grenade at a depth of 2.5 feet when passing directly over each.

The metal detector run over Test Area 2 - Trench 2 could not distinguish discrete buried UXO, but rather pegged offscale for the majority of the trench length. Onscale readings in the metal detection profile were caused by weaker signals from the smaller UXO. A profile of Test Area 2 - Trench 2 showed that the metal detector pegged offscale over the shallow end of the trench but came back onscale for targets buried deeper than a 155 mm shell at 5.0 feet.

At the seven burial pits at Test Area 2, the metal detector could only distinguish a grenade buried at 2.5 feet and a 155 mm artillery shell buried at 2.5 and 5 feet.

In summary, the metal detector had relatively shallow depth-sensing capability. Its output is usually qualitative and, therefore, has limited capability to evaluate the size and depth of targets. However, the metal

detector does provide reasonably good spatial resolution to pinpoint the location of a target.

Ground Penetrating Radar (GPR). Test GPR traverses were run by HLA with 80, 120, 500 and 900 MHZ antennas. The only distinguishable target at Test Area 1 was a 55 gallon drum in Trench 1. The drum was distinguishable only because its location was known. The GPR records showed a maximum penetration of about 3 feet with low frequency antennas (80 and 120 MHZ) and no more than one-foot with higher frequency antennas (500 and 900 MHZ). Unfortunately, anything shallower than 3 feet could not be resolved with the low frequency antennas because weak reflection is masked by the wide transmit pulse. Low frequency antennas are used for deeper penetration and they sacrifice near surface data to achieve it. It was not possible to identify trench boundaries with any degree of certainty with either the low or high frequency antennas.

At Test Area 2, a series of traverses showed that the GPR could pick up anomalies to a depth of 5 feet. As at Test Area 1, signatures were poor. Trench boundaries were poorly defined with GPR.

GPR proved ineffective at a known burial site where a drum is exposed at the surface (Test Area 3).

Earth Resistivity Method--Vertical Electrical Soundings (VES) and Electromagnetic (EM) Soundings. Both VES and EM soundings conducted by HLA at Test Area 1 showed why the GPR results were so inconclusive. The VES solution showed the ground resistivities to be relatively low at the site, because of high clay content in these soils. A thin surface veneer of 20 ohm-meter material overlies 80 ohm-meter soil that extends to below the maximum radar penetration depth. Experience has shown that GPR penetration is generally poor when ground resistivity is less than about 100 ohm-meters.

Geophysicists from Technos measured terrain conductivities of 25-30 millimhos per meter at Test Area 1 for the upper 7 meters of soils with an EM-31 terrain conductivity meter. Their experience indicated poor radar penetration is achieved when conductivities are greater than the 10

millimhos per meter (equal to 100 ohm-meter resistivity). The results of the VES and EM measurements showed that the soil at Test Area 1 is too conductive to perform successful GPR exploration.

VES and EM soundings suggested that Test Area 2 was slightly better for GPR. Soil resistivities ranged between 61 ohm-meters in the upper foot of soil to 118 ohm-meters from there down to 10 feet. EM soundings showed soils conductivities ranged between 23 and 63 millimhos per meter.

Conclusions

Efficient UXO detection depends on the ability to conduct searches in a reasonable time that are cost effective in all areas of the site. The Technos fluxgate gradiometer magnetometer and the metal detector coupled to a continuous strip chart recorder showed the most promise in locating buried UXO at the RMA site. Data suggest that the more sensitive magnetometer and gradiometer systems will detect large projectiles at much greater ranges than will metal detectors. However, the metal detector shows excellent performance for near-surface detection.

The practical detection capabilities for the continuously recorded gradiometer and metal detector systems tested at the RMA are 2.5 feet deep for a single, small hand grenade and 5 feet deep for a single, 155mm artillery shell. This practical detection limit is a function of the sensitivity of the instruments coupled with the continuous data output. If either system were used in a station measurement mode (i.e., non-continuous data), the practical detection capabilities for the same instrument would be reduced by half the depth, or more, depending upon the station spacings.

It appears that GPR will not be an effective geophysical method for clearing borings at RMA. Magnetometers can locate buried ferrous debris down to a depth of about 5 feet. The fluxgate gradiometer detected metal debris to a greater depth than either the fluxgate magnetometer or proton magnetometer. In addition, its strip chart recorded readout gives a continuous record along a traverse line rather than the discrete measurements at 5 feet intervals with HLA's fluxgate and proton magnetometers.

Geophysical Methods to be Used at RMA

Confirmation of Buried Utilities

Buried pipelines are known to exist at various locations within the RMA. In some instances, pipes may have leaked, resulting in areas of contamination in the vicinity of the pipelines. Detection of the pipelines as well as these conductive contaminants may possibly be made using geophysical methods.

The rationale for technique selection is based upon the possible metallic nature of the piping and the conductivity of the spill material. Metal pipes can be detected by a fluxgate gradiometer (magnetometer) or a metal detector. The gradiometer can be used in close proximity to buildings and other metallic materials. However, available information indicates that much of the underground piping (chemical, sanitary and storm sewers) consists of vitrified clay, rather than metal. Thus, this technique may be of limited usefulness.

Conductive material which has leaked from the buried pipes may result in increased conductivity of the subsurface materials and this can be detected using an EM device. However, EM measurements will be adversely affected by nearby metal objects (such as buildings) and power lines. Therefore, the use of the method will be evaluated on a case by case basis.

The procedures will vary with the purpose of the technique and the technique itself. The detection of underground metallic pipes will be accomplished using a fluxgate gradiometer and the contaminated subsurface around leaking pipes will be identified using an EM-31.

Fluxgate gradiometry surveys are performed by sweeping an area with the device. Indications of buried pipes are marked by flags or paint and the trace of the pipe is developed by moving laterally away from the initial detection site. In order to focus the efforts, as-built drawings are consulted to determine the suspected location of pipes. The surveys consist of determining the general location of the pipes based on the as-built facility drawings and then employing the geophysical methods to locate the pipes in the field.

Once the location of piping has been developed from record searches and the fluxgate gradiometer work and the alignments marked in an area, EM-31 measurements may be made to check for contaminated soil along the pipeline route. Continuous measurements are made along either or both sides of the alignment and anomalies marked. These zones of contaminated soils will be identified to the soil sampling team for further investigation. In some areas, buildings, power lines or other cultural features prevent the usage of the EM technique and only the gradiometry will be possible.

Survey of UXO and Other Buried Objects

In areas where UXOs or other buried objects may exist, geophysical methods will be employed to detect their presence. The known sites of UXOs will be defined in areal extent, and targets identified in order to facilitate subsequent removal. Any as yet unspecified UXO areas are potential hazards to the soil boring crews. As a result, soil boring sites will be cleared using remote sensing methods.

Similar techniques will be applied to specific contaminant sources in the areas where buried metallic objects are suspected to occur. Such sources include landfills, trenches, and pits whose detailed history is not known. Areas subject to these geophysical surveys, which are discussed in more detail in Section 3.2, include the following:

- o Site 30-4 Sanitary Landfills
- o Section 1- Uncontaminated Area
- o Section 2- Uncontaminated Area

The selection of geophysical techniques is based on the nature of the UXO or other buried metallic material. Previous experience and the geophysical test program indicate that unexploded projectiles can be identified using magnetometer and metal detection techniques. The latter is most effective when the ordnance consists of nonferrous shells. We also understand that rocket casings and aluminum rocket warheads may be present.

The methodology used to detect buried metallic material is based on the sensitivity of a fluxgate gradiometer magnetometer and a sophisticated metal detector. The gradiometer consists of a nulled pair of magnetometers which detect changes in the null field caused by small quantities of ferrous metal. Existing information indicates that the UXO material may exist at depths ranging from near the surface to as deep as 10 to 15 feet. This type of system is sensitive enough to detect ordnance at the anticipated depths.

In some cases, the metal may be non-ferrous and it will be necessary to search for the UXO using a metal detector which can detect both ferrous and non-ferrous material. Because the nature of the material will not be known beforehand, both gradiometry and metal detection will be required.

For the techniques which may be used to detect UXOs, only one procedure is required. The gradiometry and metal detection surveys will be done by establishing a series of grid lines, north-south in orientation, and approximately three feet apart. The gradiometer will be passed along each grid line and moved from side to side in order to sweep the area between adjacent grid lines. Targets identified will be flagged. The metal detector will be moved along the grid line in the same manner and targets confirmed, or new targets defined.

APPENDIX E

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SECTION III - SAMPLE SELECTION GUIDELINES FOR BUILDING SAMPLES

REVISION RECORD

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PAGE	REV.	PAGE	REV.

PREFACE

This procedure manual describes the basic sampling processes that are to be used in the environmental program at Rocky Mountain Arsenal (RMA). Because of the many different types of samples to be collected at RMA, the sampling techniques may require the sampler to use judgment. Therefore, this manual is expected to change, reflecting in subsequent revisions, sampling experiences at RMA.

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1.0 FIELD COORDINATION ACTIVITIES

1.1 Daily Briefings of RMA Personnel

The Ebasco field health and safety coordinator will brief the RMA Fire Department every morning before building entry. Pins will be placed on a map identifying the building, soil and lake sediment sampling locations where Ebasco personnel will be working that day. (Ebasco personnel refers to Ebasco employees and Ebasco subcontractor personnel.) In addition, the health and safety coordinator will fill out a Daily Field Work Plan (Figure 1-1) in the Health and Safety notebook. The carbon copy will be removed from the notebook and left with the Fire Chief or his representative each morning. The Chief of Facility Operations also is to be briefed. Typically, the briefing at the fire station will suffice. However, weekly communications between the on-site personnel and Facility Operations will be maintained. Any other relevant information necessary to assist in the work activities for that day will be exchanged between fire station and operations personnel of RMA and the health and safety officer and onsite coordinator of Ebasco.

This daily contact will aid in ensuring the safety of Ebasco personnel in the event of an emergency in the field, and it also will help to maintain a good working relationship with RMA personnel.

1.2 Daily Safety Meeting for Sampling Teams

Each work day prior to any sampling activity, the health and safety coordinator will conduct a safety meeting at Ebasco's command center. Attendance is mandatory for all project personnel working that day at RMA.

This meeting is the forum for transmitting relevant information to, and among, Ebasco team members in the field. The health and safety coordinator and onsite sampling team coordinator will discuss the day's activities, briefing personnel on specific aspects of the daily work plan. In addition, important safety considerations will be covered, reviewed, and emphasized. Any peculiar or unusual aspects of work or sampling for that day will be

EBASCO/ENVIROSPHERE

DAILY FIELD WORK PLAN

DATE:_____

EBASCO CONTACT:_____

PHONE NUMBER:_____

AREA OF WORK IN SOUTH PLANTS TODAY

BUILDINGS:

DRILLING SITES:

ANTICIPATED UNUSUAL SITUATIONS:

ESTIMATED QUITTING TIME TODAY:_____

_____

SIGNATURE OF PERSON MAKING THIS REPORT

Figure 1-1 Daily Field Work Plan

covered. Also, decontamination and emergency evacuation procedures applicable to that day's work will be discussed.

A copy of the outline to be used by the health and safety coordinator to prepare for this daily safety meeting is included in Appendix A of this document. At the conclusion of the daily safety meeting, the health and safety coordinator will record in the Health and Safety notebook all outline items discussed that morning and any relevant comments. At a minimum, items discussed and personnel in attendance will be recorded daily in this notebook.

1.3 Command Post Personnel

- Geotechnical Coordinator
  (will not be on-site at all times)
- On-Site Sampling Team Coordinator and
  Sample Coordinator
- Health and Safety Technician

2.0 BUILDING SAMPLING PROCEDURES FOR RMA

2.1 Introduction

The following delineates procedures to be used in building sampling at Rocky Mountain Arsenal (RMA). The intent is to present a logical sequence of events for sampling the buildings during the Phase I portion of the RMA program.

2.2 Sampling Personnel

Building Sampling Personnel

- o Ebasco Field Health and Safety Coordinator
- o Air Monitoring Specialist
- o Sample Collection
- o Technician
- o Technician

Alternate Personnel

- o Structural Engineer
- o Process Engineer

2.3 Building Entry Procedures

The air monitoring specialist and the health and safety coordinator will be the first project personnel to enter any building. They will be in Level C protection as a minimum and carry a two-way radio. However, as deemed necessary by the Field Health and Safety Coordinator, higher levels of protection may be used. Where considered necessary, they will carry emergency escape air bottles. (For specifics on level of protection and health and safety, see the project Health and Safety plan.)

Before any building entry, the health and safety coordinator, the air monitoring specialist, and the sample collector will walk around the outside

of the building. The health and safety coordinator will note potential hazards to the safety of sampling personnel such as physical structures (low beams, wires) and health factors (heat stress, etc.). The air monitoring specialist will gather background readings from the reatime air monitoring instruments. The sample collector will record the meter readings as part of the building sampling record. This completed, they will prepare to enter the building.

The use of instrumentation for safety purposes is heavily relied on when entering a building. This equipment includes an organic vapor analyzer (OVA), an HNU meter, a M260 (or M360) meter, a mercury monitor, a chlorine meter, an M8 alarm, a M18A2 field kit, personal samplers including a Gilian pump and Tenax charcoal filters, a dust monitor, and a phosgene monitor. The general purpose of each meter is shown in Table 2-1.

The air monitoring specialist will first move the M8 Alarm into the building. If the alarm does not sound within 15 to 30 seconds, entry will be made carrying the M8 Alarm, the OVA, the HNU analyzer, and the M260 meter. In special situations, as determined by the health and safety coordinator, additional meters will be used as part of the entry procedure.

The air monitoring specialists and the health and safety coordinator will work their way into the building. First the M8 Alarm will be moved ahead, followed by the OVA meter. This procedure will be used to proceed into the building during the initial building entry phase.

After the initial entry, further instrumentation is carried into the building. The health and safety coordinator may also use the Army M18A2 Chemical Agent kit to test the air in the building for the presence of Army Surety agents. If surety agents are detected, the building will be exited and the Fire Department and Tech Escort notified. The building will not be reentered until it has been cleared and certified agent free by the Army.

A determination will be made, using real time monitoring instrumentation, whether the atmosphere in the building meets at least the following Level C safe entry criterion. These criteria are as follows:

TABLE 2-1

PURPOSE OF MONITORING EQUIPMENT
FOR HEALTH AND SAFETY

Equipment	General Purpose
Organic vapor analyzer (OVA) (Flame ionization detector [FID])	Monitors for organic compounds
HNU analyzer (Photoionization detector [PID])	Monitors for organic compounds
M260 (or M360) meter	Combustible gas meter and oxygen alarm
Mercury monitor	Monitors for mercury vapor
Chlorine meter	Monitors for chlorine gas
M8 Alarm	Nerve gas (GB) detector
M18A2 Field Kit	Army surety detector (mustard, lewisite)
Personal samplers (Gilian pumps, Tenax charcoal filters)	Filter for specified compounds
Dust monitor	Monitors ambient dust levels
Phosgene monitor	Monitors for phosgene gas

< 5 ppm reading on the FID meter
< 5 ppm reading on the PID meter
> 19.5% reading on the Oxygen meter
< 25% of the Lower Explosion Limit (LEL) on the Combustible Gas Indicator

Other instrumentation will be used as appropriate to evaluate safe entry at Level C.

If any of the criteria are exceeded, all personnel (the air monitoring specialist, sampling technician and the health and safety coordinator) will exit the building. Subsequently, it will be determined if the building will be entered with an upgraded level of protection, and if so, how to safely complete the reconnaissance survey.

The health and safety coordinator will inform the command post, via two-way radio, that the building is cleared for entry. (Entry to the building is considered crossing the hot line.) At this time, the sample collector will enter the building.

While the sample collector is performing his/her duties, the air monitoring specialist will continue to monitor the air in the building. These readings will be recorded by the sample collector. If certain locations show high PID or FID readings they will be identified. The air monitoring specialist will use this information to set up a sample pump with charcoal and tenax tubes to take an area sample for organics in the building. The length of time for this sample will be predetermined by the air monitoring specialist to assure that a valid sample will be taken.

In some cases building sampling activities may be complete prior to the collection of the area sample for volatile organics. This will necessitate adjustments in the retrieval of this sample since someone will have to return to the building to collect this sample. Sample pumps are equiped with automatic timers for preset shutoff. In situations where the sample collection time extends past normal working hours, this area sample will not be taken that day, but will be taken in the building the morning of the next work day.

The health and safety coordinator will remain in the building to monitor activities of personnel working inside the building and take photographs. The sample collector will observe and report observational data that is to be used to update the building contamination assessment report. In particular, the sample collector will note areas and facilities such as drains, sumps, sewer inlets, etc., that may lead to environmental, soil and water contamination. This report of observational data will be recorded on paper and/or tape recorder. At the end of the work day, the paper record will be xeroxed. The xerox copies will be filed in a file for that building. Tapes will be transcribed with these transcriptions becoming part of the building file. Duplicates of this building file will be kept in the Santa Ana office of Ebasco.

Identification of potential sample locations, if any, for the Phase IB sampling program will be identified by the air monitoring specialist. Notes will be made of meter readings at these Phase IB sample locations, suggested sampling equipment to be used, and any other significant information.

Photographs will be taken by the sample collector to further characterize the conditions in the building. The sample collector will record the frame number of the picture on the paper record, and indicate the direction in which the picture was taken with an arrow on the building plan. (The roll number of the film will have been identified when loaded into the camera.)

While the sample collector is gathering the observation data, she/he will also be collecting the composite dust sample from surfaces within the building. Collection of the composite dust sample will be done using a sample scoop and small paint brush to sweep dust into the scoop. This will be a bulk area sample from various surfaces inside the building. It is expected that these surfaces will be ledges, desktops, rafters, windowsills, floor areas, and so forth.

The building sampling team is now ready to proceed through the contamination reduction zone to the decontamination area. If the team is going to proceed to the next building, the sampling team will wash contaminated boot covers and outer gloves and replace them with clean boot covers and outer gloves.

If a break, lunch or end of shift is the next scheduled activity, the building sampling crew will proceed through the contamination reduction zone and follow the decontamination procedures to be used that day.

2.4 Special Building Sampling Circumstances

Structural Problems

Buildings identified as having questionable structural integrity will be evaluated by the project's structural engineer. The preceding building entry procedure will be modified to have the structural engineer join the air monitoring specialist and health and safety coordinator during the initial building entry.

The structural engineer will observe and evaluate the building's structural integrity. Potential hazards to personnel entering the building will be identified. The structural engineer will make known any observations of structural flaws or questionable safety situations to the health and safety coordinator.

If input from the structural engineer leads the health and safety coordinator to determine that sampling cannot be safely accomplished, the sampling team will exit the building without sampling it. If it is determined that the building can be safely sampled, sampling will proceed as described in the previous section (Section 2.3). The structural engineer will record his/her findings in the field data logbook.

Tank Storage Areas

There will be no sampling inside tanks during Phase IA. In areas where tanks are present, a walk through reconnaissance will be done. Air monitoring will be done by the air monitoring specialist and the health and safety coordinator. The sample collector will gather the observational data. Sample locations and possible samples to be taken from around or in tanks during the Phase IB sampling effort will be identified.

2.5 Building Sampling Methods for RMA

Specific sampling procedures discussed herein are guides to good sampling protocol. Furthermore, it is understood that outer gloves will be removed and replaced with clean gloves prior to taking another sample. This is done to minimize cross-contamination between samples.

Any other steps helpful in preventing unnecessary spilling of samples on, or near, the sample bottle and sampling personnel should be implemented. This will make decontamination easier.

The first three methods (scoop, pond sampler, and glass tubes) are envisioned as the primary sampling methods for the Phase IA and IB building program at RMA. The other methods are included as possible alternatives, if the particular sampling need arises.

Scoop

Uses

The scoop is used to collect soil samples up to 8 cm (3 in) deep. It is simple to use, but identical mass sample units for a composite sample are difficult to collect with this sampler. At RMA, the scoop also will be used to collect composite dust samples from the buildings during Phase IA.

Procedure for Use

1. At regular intervals, take small equal portions of sample from the surface or near the surface of the material to be sampled. Remember, a different brush will be used for each building.

2. Combine the samples in a suitable container.

3. Cap the container.

4. Deliver the sample to the sample coordinator.

5. Label and affix the seal; record in field log book; and complete sample analysis request sheet and chain of custody record.

Procedure for Use at RMA

1. Place the scoop on the surface where the dirt is to be collected from. Gently sweep the dust into the scoop with the paint brush.

2. Transfer the dust to the sample bottle. Pour dust into sample bottle slowly to avoid losing part of the sample.

3. After the last scoop has been transferred to the sample bottle, gently stir the contents of the bottle with a stainless steel spatula.

4. Extract a portion of the sample and transfer it to the container used for Army Surety agent field analysis.

5. Cap the container; do the Army Surety agent field analysis; record the results.

6. Deliver the sample to the sample coordinator.

7. Label and affix the seal; record in field log book; and complete sample analysis request sheet and chain of custody record.

Pond Sampler

Uses

The pond sampler is used to collect liquid waste samples from disposal ponds, pits, lagoons, and similar reservoirs. At RMA, the pond sampler will be used to collect samples from pits, sumps, and manholes.

Procedure for Use

1. Assemble the pond sampler. Make sure that the sampling beaker and bolts and nuts that secure the clamp to the pole are tightened properly.

2. With proper protective garment and gear, take grab samples from the pond at different distances and depths.

   For RMA - Use pond sampler to scoop sediments or sludges from sumps, tanks, or sewer manholes.

3. Combine the samples in one suitable container.

4. Cap the container.

5. Dismantle the sampler; wipe the parts with terry towels or rags and store them in plastic bags for subsequent cleaning. Store used towels or rags in garbage bags for subsequent disposal.

6. Deliver the sample to the sample coordinator.

7. Label and affix the seal; record in field log book; and complete sample analysis request sheet and chain of custody record.

Glass Tubes

Description

Liquid samples from opened containers (55-gallon drums) are collected using lengths of glass tubing. The glass tubes are normally 122 cm in length and 6 to 16 mm inside diameter. Larger diameter tubes may be used for more viscous fluids if sampling with the small diameter tube is not adequate. The tubing is broken up and discarded in the container after the sample has been collected, eliminating difficult cleanup and disposal problems. This method should not be attempted with less than a two-person sampling team.

Uses

This method provides for a quick, relatively inexpensive means of collecting concentrated containerized wastes. The major disadvantage is from potential sample loss which is especially prevalent when sampling less viscous fluids. Splashing can also be a problem and proper protective clothing (e.g., butyl rubber apron, face shields, boot covers) should always be worn.

Procedure for Use

1. Remove cover from sample container opening.

2. Insert glass tubing <u>almost</u> to the bottom of the container. Try to keep at least 30 cm of tubing above the top of the container.

3. Allow the waste in the drum to reach its natural level in the tube.

4. Cap the top of the tube with a safety-gloved thumb or a rubber stopper.

5. Carefully remove the capped tube from the drum and insert the uncapped end in the sample container.

6. Release the thumb or stopper on the tube and allow the sample container to fill to approximately 90 percent of its capacity.

7. Repeat steps 2 through 6 if more volume is needed to fill the sample container.

8. Remove the tube from the sample container and replace the tube in the drum.

9. Cap the container.

10. Break the glass sampling tube in such a way that all parts of it are discarded inside the drum.

11. Replace the bung or place plastic over the drum.

12. Deliver the sample to the sample coordinator.

13. Label and affix the seal; record in field log book; and complete sample analysis request sheet and chain of custody record.

Optional Method (if sample of bottom sludge is desired)

1. Remove cover from container opening.

2. Insert glass tubing slowly almost to the bottom of the container. Try to keep at least 30 cm of tubing above the top of the container.

3. Allow the waste in the drum to reach its natural level in the tube.

4. Gently push the tube towards the bottom of the drum into the sludge layer. Do not force it.

5. Cap the top of the tube with a safely-gloved thumb or rubber stopper.

6. Carefully remove the capped tube from the drum and insert the uncapped end in the sample container.

7. Release the thumb or stopper on the tube and allow the sample container to fill to approximately 90 percent of its capacity. If necessary, the sludge plug in the bottom of the tube can be dislodged with the aid of a stainless steel laboratory spatula.

8. Repeat if more volume is needed to fill sample container and recap the tube.

9. Proceed as in Steps 9 through 13 above.

NOTE

a. If a reaction is observed when the glass tube is inserted (violent agitation, smoke, light, etc.), the investigators should leave the area immediately.

b. If the glass tube becomes cloudy or smokey after insertion into the drum, the presence of hydrofluoric acid is indicated and a comparable length of rigid plastic tubing should be used to collect the sample.

c. When a solid is encountered in a drum (either layer or bottom sludge) the optional method described above may be used to collect a core of the material, or the material may be collected with a disposable scoop attached to a length of wooden or plastic rod.

Kemmerer Bottle

Discussion

The Kemmerer bottle is a messenger-activated water sampling device. In the open position water flows easily through the device. Once lowered to the desired depth a messenger is dropped down the sample line tipping the release mechanism and closing the bottle. In the closed position the bottle is sealed, both on top and bottom, from any additional contact with the water column and can be retrieved.

Most commercially available Kemmerer bottles are of brass or plastic construction. Modification of existing systems with nonreactive materials such as Teflon, glass or stainless steel would be only partially successful due to the complicated machining necessary for the release mechanism. Other modifications such as a stoppered bottom drain are simpler and useful in minimizing sample disturbance during transfer to the appropriate containers.

Uses

The Kemmerer bottle is currently the most practical method of collecting discrete, at-depth samples from surface waters or vessels where the collection depth exceeds the lift capacity of pumps. The application is limited however by the incompatability of various construction materials with some analytical techniques. Proper selection, i.e., all metal assemblies for organic analysis or all plastic assemblies for trace element analysis, will overcome this deficiency.

Procedure for Use

1. Inspect Kemmerer bottle for thorough cleaning and insure that sample drain valve is closed (if bottle is so equipped).

2. Measure and then mark sample line at desired sampling depth.

3. Open bottle by lifting top stopper--trip head assembly.

4. Gradually lower bottle until desired level is reached (predesignated mark from Step 2).

5. Place messenger on sample line and release.

6. Retrieve sampler; hold sampler by center stem to prevent accidental opening of bottom stopper.

7. Rinse or wipe off exterior of sampler body (wear proper gloves and protective clothing).

8. Recover sample by grasping lower stopper and sampler body with one hand (gloved), and transfer sample by either (a) lifting top stopper with other hand and carefully pouring contents into sample bottles, or (b) holding drain valve (if present) over sample bottle and opening valve.

9. Allow sample to flow slowly down side of sample bottle with minimal disturbance.

10. Preserve the sample if necessary.

11. Check that a Teflon liner is present in the cap if required. Secure the cap tightly.

12. Deliver the sample to the sample coordinator.

13. Label the sample bottle with an appropriate tag. Be sure to complete the tag with all necessary information. Record the information in the field logbook and complete all chain of custody records.

14. Place the properly labeled sample bottle in an appropriate carrying container maintained at 4°C throughout the sampling and transportation period to the laboratory.

15. Decontaminate sampler and messenger or place in plastic bag for return to decontamination area.

Coliwasa Sampler

Uses

The plastic Coliwasa is used to sample most containerized liquid wastes except wastes that contain ketones, nitrobenzene, dimethylforamide, mesityl oxide, and tetrahydrofuran. The borosilicate glass Coliwasa is used to sample all other containerized liquid wastes that cannot be sampled with the plastic Coliwasa except strong alkali and hydrofluoric acid solutions.

Procedure for Use

1. Choose the plastic or glass Coliwasa for the liquid waste to be sampled and assemble the sampler.

2. Make sure that the sampler is clean.

3. Check to make sure the sampler is functioning properly. Adjust the locking mechanism if necssary to make sure the neoprene rubber stopper provides a tight closure.

4. Wear necessary protective clothing and gear and observe required sampling precautions.

5. Put the sampler in the open position by placing the stopper rod handle in the T-position and pushing the rod down until the handle sits against the sampler's locking block.

6. Slowly lower the sampler into the liquid waste. (Lower the sampler at a rate that permits the levels of the liquid inside and outside the sampler tube to be about the same. If the level of the liquid in the sampler tube is lower than that outside the sampler, the sampling rate is too fast and will result in a nonrepresentative sample).

7. When the sampler stopper hits the bottom of the waste container, push the sampler tube downward against the stopper to close the sampler. Lock the sampler in the close position by turning the T handle until it is upright and one end rests tightly on the locking block.

8. Slowly withdraw the sampler from the waste container with one hand while wiping the sampler tube with a disposable cloth or rag with the other hand.

9. Carefully discharge the sample into a suitable sample container by slowly opening the sampler. This is done by slowly pulling the lower end of the T handle away from the locking block while the lower end of the sampler is positioned in a sample container.

10. Cap the sample container.

11. Unscrew the T handle of the sampler and disengage the locking block. Clean sampler on site or store the contaminated parts of the sampler in a plastic storage tube for subsequent cleaning. Store used rags in plastic bags for subsequent disposal.

12. Deliver the sample to the sample coordinator.

13. Label and affix the seal; record in field log book; and complete sample analysis request sheet and chain of custody record.

Weighted Bottle Sampler

Uses

The weighted bottle sampler can be used to sample liquids in storage tanks, wells, sumps, or other containers that cannot be adequately sampled with the Coliwasa. The sampler cannot be used to collect liquids that are incompatible or that react chemically with the weight sinker and line.

Procedure for Use

1. Assemble the weighted bottle sampler.

2. Using protective sampling equipment, in turn, lower the sampler to proper depths to collect the following samples:

   a. upper sample - middle of upper third of tank contents.
   b. middle sample - middle of tank contents.
   c. lower sample - near bottom of tank contents.

3. Pull out the bottle stopper with a sharp jerk of the sampler line.

4. Allow the bottle to fill completely, as evidence by the cessation of air bubbles.

5. Raise the sampler and retrieve and cap the bottle. Wipe off the outside of the bottle with a terry towel or rag. The bottle can serve as the sample container.

6. Label each of the three samples collected.

7. Clean onsite or store contaminated sampler in a plastic bag for subsequent cleaning.

8. Deliver the sample to the sample coordinator. The sample coordinator will instruct the laboratory to perform analysis on each sample or a composite of the samples.

9. Label and affix the seal; record in field log book; and complete sample analysis request sheet and chain of custody record.

Grain Sampler

Uses

The grain sampler is used for sampling powdered or granular wastes or materials in bags, fiber drums, sacks, or similar containers. This sampler is most useful when the solids are no greater than 0.6 cm (1/4 in) in diameter.

Procedure for Use

1. While the sampler is in the close position, insert it into the granular or powdered material or waste being sampled from a point near a top edge or corner, through the center, and to a point diagonally opposite the point of entry.

2. Rotate the inner tube of the sampler into the open position.

3. Wiggle the sampler a few times to allow materials to enter the open slots.

4. Place the sampler in the close position and withdraw from the material being sampled.

5. Place the sampler in a horizontal position with the slots facing upward.

6. Rotate and slide out the outer tube from the inner tube.

7. Transfer the collected sample in the inner tube into a suitable sample container.

8. Collect two or more core samples at different points and combine the samples in the same container.

9. Cap the sample container.

10. Clean or store the sampler in plastic bag for subsequent cleaning.

11. Deliver the sample to the sample coordinator.

12. Label and affix the seal; record in field log book; and complete sample analysis request sheet and chain of custody record.

Sampling Trier

Uses

The use of the trier is similar to that of the grain sampler. It is preferred over the grain sampler when the powdered or granular material to be sampled is moist or sticky. In addition, the sampling trier can be used to obtain soft or loosened soil samples up to a depth of 61 cm (24 in) as outlined below.

Procedure for Use

1. Insert the trier into the waste material at a 0 to 45° angle from horizontal. This orientation minimizes the spillage of sample from the sampler. Extraction of samples might require tilting of the containers.

2. Rotate the trier once or twice to cut a core of material.

3. Slowly withdraw the trier, making sure that the slot is facing upward.

4. Transfer the sample into a suitable container with the aid of a spatula and/or brush.

5. Repeat the sampling at different points. Two or more times and combine the samples in the same sample container.

6. Cap the sample container.

7. Wipe the sampler clean, or store it in a plastic bag for subsequent cleaning.

8. Deliver the sample to the sample coordinator.

9. Label and affix the seal; record in field log book; and complete sample analysis request sheet and chain of custody record.

Waste Pile Sampler

Uses

The waste pile sampler is used for sampling wastes in large heaps with cross-sectional diameters greater than 1 m (39.4 in). It can also be used for sampling granular or powdered wastes or materials in large bins, barges, or silos where the grain sampler or sampling trier is not long enough. This sampler does not collect representative samples when the diameters of the soil particles are greater than half the diameter of the tube.

Procedure for Use

1. Insert the sampler into the waste material being sampled at 0 to 45^{o} from horizontal.

2. Rotate the sampler two or three times in order to cut a core of the material.

3. Slowly withdraw the sampler, making sure that the slot is facing upward.

4. Transfer the sample into a suitable container with the aid of a spatula and/or brush.

5. Repeat the sampling at different sampling points two or more times and combine the samples in the same sample container in step 4.

6. Cap the container.

7. Wipe the sampler clean or store it in a plastic bag for subsequent cleaning.

8. Deliver the sample to the sample coordinator.

9. Label and affix the seal; record in field log book; and complete sample analysis request sheet and chain of custody record.

3.0 SOIL SAMPLING PROCEDURES FOR RMA

3.1 Introduction

The following delineates the procedures used in soil sampling at RMA. Further information on the technical requirements for drilling, well construction and aquifer testing are included in Appendix C. Geophysical methods to be used in conjunction with soil sampling are described in Appendix D.

3.2 Sampling Personnel

- o Drilling Health and Safety Leader
- o Soil Sampling Team Leader
- o Driller
- o Driller Helper
- o Geologist
- o Geologist

3.3 Health and Safety

At the start of the work day the drilling health and safety leader assigned to the soil sompling program will provide the Ebasco on-site health and safety coordinator with the drilling locations for the day and obtain from the health and safety team the monitoring equipment needed for the day's activities. The drilling health and safety leader will conduct a safety meeting at the drill site each work day prior to any drilling activity. The purpose of this meeting is similar to that of the daily safety briefing for the building program.

3.4 Soil Sampling Methods for RMA

The soil sampling method to be used at RMA has been developed for USATHAMA by Ebasco, Harding Lawson, R. L. Stollar & Associates, ESE and Geraghty & Miller makes use of clear polybutyrate coring tubes.

Hollow-stem auger (6-inch ID) will be used to drill through the alluvium and the Denver Formation at RMA. The rig will be equipped with a continuous coring device. The core barrel will contain clear polybutyrate tubes that collect the core. The tubes will be precut so that 1-foot, 3-foot and 4-foot sections are available at the drill site. The 1-foot sections are the sample sections and will be solid core pieces. The 3- and 4-foot sections will be scored on opposite sides of the diameter to aid in opening the core for field analysis and logging.

The general procedures for drilling and continuous coring are as follows:

1. Enough augers and core barrels will be available so that one set may be in use while another set is being decontaminated. Decontaminate enough equipment and sampling tubes for the projected daily need.

2. Set up rig at the staked and cleared borehole location.

3. Designate a decontamination area for rig tools and a preliminary decontamination area for personnel.

4. Designate a work area to log and take samples. This may be a covered area or the back of a pickup.

5. Prepare sampling materials knowing drilling depth. Record location, date, time and other pertinent information on boring log form, chain of custody form, sample labels, and activity sheets.

6. Brush out core barrel, place steam cleaned polybutyrate liners cut to specification into the core barrel.

7. Commence augering and coring.

8. Remove the core barrel after the first 1-foot increment and at each 5-foot increment thereafter.

9. Use the safety monitoring equipment over the borehole to determine the level of volatile emissions in the augered borehole.

10. Mark the polybutyrate liner sections that have been removed from the core barrel with an arrow pointing to the top end, the boring number, and depth interval. A label giving the same information as well as project number and name, date, and geologist's initials will be placed on each one half section of the stored core prior to splitting the core open. Label the 12-inch sample core sections that will be sent to the laboratory with red labels.

11. Split, log, and scan all other core sections with an OVA meter to determine the relative level of organics in the sections.

12. Do not open the core samples that will be sent to the laboratory for analysis. Cover the ends with teflon sheets and tape them closed. The core samples will be logged visually through the polybutyrate liner. Place the core samples in a cooler with an ice pack.

13. Tape and seal the core sections with caps to prevent opening during transport. Take the cores to the storage facility on the Arsenal at the end of the working day. Place the core sections in the core boxes for storage and label the core boxes.

14. Place steam cleaned polybutyrate liners in the brushed clean core barrel for each additional 5-foot depth increment to be cored.

15. Repeat steps 5 through 14 until boring is completed.

16. The boring is complete when the predetermined depth is reached, or when the water table is reached--whichever is reached first.

17. Transport all the sample core sections to the support facility for sample shipment preparation by the sample coordinator.

18. As the cuttings fall from the auger flygt, they form a cone around the borehole opening. The typical cone is about a foot high and one and one half feet in diameter. The actual size of the cone is dependent on the volume of cuttings and therefore the depth of the borehole. The

core should be left in place and grouted in place when the borehole is grouted.

19. Leave the borehole location stake in the ground adjacent to the borehole, and place a sheet of plastic and a board over the hole until it has been grouted.

20. Grout the borehole and cone of cuttings and place the borehole location stake in grout the same day of drilling.

21. Upon completion of each borehole, decontaminate the augers and other down hole equipment in an on-site decontamination pit prior to moving to the next borehole on-site.

22. Upon completion of each site, move all equipment to the decontamination pad. Decontaminate the rig and the larger drill equipment prior to moving to the next site.

23. Check supplies at end of the work day to see that enough equipment is available for a full day's work the next day. If supplies are not complete, fill them at the end of the work day prior to their being needed.

24. Transfer copies of drilling and core logs to the support facilities.

The general procedures outlined above for drilling and continuous coring should be followed unless exceptions or emergencies occur. Some of the expected exceptions and the additional procedures are as follows:

1. If enough unscored 1-foot polybutyrate tubing is unavailable for the day's drilling, use of a 1-foot section of the scored is preferable to delay of drilling. Supplies should be checked at the end of each work day.

2. If scored polybutyrate tubing becomes too difficult to cut with the hand held knife, use of a battery powered drill with a saw blade is acceptable.

3. If the water table is encountered at a depth other than the pre-set 5, 10, 15 or 20 foot depth, a sample should be taken of the 1-foot section immediately above the water table by cutting the longer lengths of scored polybutyrate tubing at the appropriate locations.

4. If core material and/or sample is lost during drilling, the fact should be noted in both the core and drilling logs and the lost material's properties should be estimated for the logging, and it should be noted in the record that an estimate has been made.

5. If drilling and logging must be stopped due to weather or safety practices, the unlogged cores should be covered, labeled, and transported to a covered holding area for protection until logging and sampling can be completed.

6. If drilling and logging must be stopped due to safety problems and the level of protection must be raised to higher than a C level for drilling, qualified persons must retrieve the core that is out of the hole. The core should be examined and labeled in an open area and stored or sampled in the proper manner. The borehole should be plugged in the approved manner, and the rig decontaminated before moving to the next hole.

7. If monitoring equipment detects a significant level of volatile emissions from an unsampled section of the core, the section should be sampled. Samples should be cut from the core with a stainless steel knife, then placed in containers appropriate to sampling for each analyses regularly run on the standard core samples. Label appropriately.

3.5 Equipment Decontamination

To prevent cross-contamination between boreholes, the augers and core barrels should be decontaminated after use. To prevent cross-contamination between boreholes, the rig should be protected with plastic sheetings near the borehole to minimize splashing. The rig should be rinsed with the steam

cleaning equipment to remove mud at the borehole before moving to a new borehole. The rig must be brushed and moved to the steam cleaning pad for decontamination before moving to a different site. The polybutyrate core tubes should be steam cleaned and air dried before use. The teflon sheets and the PVC caps which are placed over the ends of the stored cores should be washed prior to use. The decontamination procedures are as follows:

1. Teflon Sheets and PVC Caps

    a. Wash in a mild detergent
    b. Rinse in clean tap water
    c. Air dry
    d. Store cleaned materials in plastic bags to prevent contamination with dust

2. Core Barrels, Ends, and Polybutyrate Tubes

    a. Brush off excess material
    b. Wash in a mild detergent
    c. Steam clean with clean tap water
    d. Rinse with distilled, deionized water
    e. Air dry
    f. Store clean materials in uncontaminated area

3. Augers

    a. Brush clean of excess material
    b. Steam clean with clean tap water
    c. Air dry
    d. Store clean materials in uncontaminated area

4. Drill Rig

    a. Remove protective plastic
    b. Brush clean before leaving site
    c. Steam clean before setting up on new site
    d. Place protective plastic on rig before drilling

4.0 LAKE SEDIMENT SAMPLING PROCEDURES FOR RMA

4.1 Introduction

This sampling methodology is to be used for lakes, drainage ditches, and ponds that contain standing or flowing water or where the soil is very wet and is therefore not accessible to a standard drilling rig. Typical sites would be bottom sediments in Lake Mary and Lake Ladora. As long as hand augering can be carried out, this methodology is applicable to sites where access with a truck-mounted auger rig is unsafe or impossible. Sampling by this method limits sampling depth to five feet or less.

Three types of sediment collection situations may be encountered depending on the amount of water present at a sampling point. These are:

a. Dry sediment sampling - areas where normal soil conditions exist (i.e., not marshy or covered with water) but access with a standard drill rig is difficult.

b. Wet sediment sampling - areas were, due to moisture content of soil, standard access to the site is not possible and the texture of soil is sufficiently soft to allow standard hand coring devices to be used.

c. Lake sediment areas - areas where surface water is present and access by boat or barge is necessary.

Three aspects of each of these sampling methodologies will be described--sample location, equipment needed, soil boring recovery.

4.2 Dry Sediment Sampling

If landmarks exist, the sampling points will be located a compass and pacing. If it is difficult to locate sites with confidence, the sites will be surveyed. After the sample is collected, the sampling site will be marked with a painted and flagged 4-foot stake for location by surveying.

Access will be by foot and no special foot or leg gear (such as waders) will be necessary. A two-inch ID split spoon sampler fitted with a polybutyrate collection tube will be used for sample collection. It will be equipped with a basket shoe to retain the soil sample.

The device will be driven into the sediment to a depth of three feet, the sampler removed, logged and a composite collected. Removal of the sampler at this depth may require the use of a pipe wrench or other grappling device to remove the core. The sample will be logged according to the soil type and the sample core will be split and composited for chemical analysis. Samples to be assayed for organics will be placed in amber glass bottles with Teflon lined screw capped lids, volatile organic samples will be placed in VOA septum vials and samples for metals analyses will be placed in plastic bottles with screw capped lids for storage and shipment.

The sampler will be wiped, brushed, rinsed, steam cleaned, rinsed with distilled water and air dried to prevent core cross-contamination.

4.3 Wet Sediment Sampling

Sampling locations will be located in the same manner as in 4.2. The final location will be marked with a flagged and painted stake. The length of the stake will depend on character of the sampling area.

Access will be by foot. Waders or high boots may be necessary depending on depth of standing water or condition of the sampling area. The sampling equipment will include:

1. Two inch ID Wildco Model 2424-A15 sampler with a plastic catcher, nosepiece and polybutyrate sleeve.

2. Split spoon sampler may be necessary if tight soil is encountered. It will be of the same type described above.

3. A five or ten pound maul may be required for driving sampler.

4. Grappling device may be needed to remove sampler from the soil.

The sampling device will be driven to a three to five foot depth (if possible). In the first few feet the sampler may probably be advanced by pushing. The remainder of the coring device may need to be driven with a maul. If sediment recovery is possible using the Wildco extended device for the entire sampled interval then the sample will be removed, logged, split and a sample composited for analysis.

Composited samples for organics analysis will be placed in amber glass bottles with Teflon lined screw capped lids, volatile organic samples will be placed in VOA septum vials and samples for metals analyses will be placed in plastic bottles with screw capped lids for storage and shipment.

The sampling device will be wiped with a clean cloth and steam cleaned after the total core has been collected to prevent core cross contamination.

4.4 Lake Sediment Sampling

These are areas where sediments are covered by standing water and are accessible by boat. The boat used for the lake sampling will be a raft constructed of plywood on small pontoons. An area in the center of the raft will be left open for sampling. A winch and swinging arm which may be adapted for motor drive will be mounted adjacent to the central port to aid in the lowering and raising of the coring device from the lake bottom.

a. The grid for locations of lake sampling points will be roughly staked on the shoreline. The raft will then be transported to the approximate sampling locations and anchored. A sampling point will be marked with a buoy secured by a cement block end line. This point will be located along with the stakes after sampling is complete.

b. Equipment needed will be:

1. The sampling raft with motor fitted with a power winch (if deemed necessary).

2. Extended sampling device described in "Wet Sediment Sampling."

3. Ten pound maul for driving sampler.

4. Buoys for making sampling locations.

c. The rig will first be centered over the sampling location, anchored, and sampler lowered to the lake bottom using the winch and extension. The corer will be advanced as far as possible by hand pushing and the remainder of the travel will be aided by pounding with a ten pound maul. The entire core will be removed at once using the winch to aid in removal. Sediment will first be logged then split and a sample composited for chemical analysis.

Composited samples for organics analysis will be placed in amber glass bottles with Teflon lined screw capped lids, volatile organics samples will be placed in VOA septum vials, and samples for metals analysis will be placed in plastic bottles with screw capped lids for storage and shipment.

The sampling device will be wiped with a clean cloth and steam cleaned after the total core has been collected to prevent core cross contamination.

5.0 SEWER LINE SAMPLING PROCEDURES FOR RMA

(Reserved for future use.)

6.0 GROUNDWATER SAMPLING PROCEDURES FOR RMA

(Reserved for future use.)

7.0 SURFACE WATER SAMPLING PROCEDURES FOR RMA

(Reserved for future use.)

8.0 AIR QUALITY SAMPLING PROCEDURES FOR RMA

(Reserved for future use.)

9.0 BIOTA SAMPLING PROCEDURES FOR RMA

(Reserved for future use.)

10.0 SAMPLE MANAGEMENT AND DOCUMENTATION

10.1 Introduction

Samples are the physical evidence collected from a site. The integrity of this gathered evidence depends on stringent documentation of sample management from collection to data reporting. This facilitates the ability to trace the possession and handling of physical evidence from the point of collection through analyses and final data deposition. The historical documentation of a sample is known as chain of custody.

The information presented in these sections briefly summarizes the major aspects of sample management and documentation. A more detailed review can be found in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846, July 1982), National Enforcement Investigation Center Policy and Procedures (EPA-330/9-78-001-R, revised February 1983), Sample and Chemical Analysis Quality Assurance Program for U.S. Army (USATHAMA, 1982), or other documents as appropriate. The following material discusses selection of sample containers, sample identification, chain of custody records, transfer of custody, and sample shipment.

10.2 Selection of Sample Containers

Important factors to consider when selecting containers for hazardous materials samples are compatibility with the sample, resistance to breakage, container volume, and cost. Containers for collecting, storing, and shipping hazardous materials must not distort, rupture, or leak due to chemical reactions among constitutents of the sample. These containers should also be resistant to breakage under field conditions and during transport to the laboratory. Containers should be easy to use under field conditions. These containers are usually made of glass or plastic.

Glass containers are relatively inert to most chemical agents and can be used to collect, store, and transport all classes of hazardous materials except hydrofluoric acid and strong alkali. Borosilicate glass containers (e.g., Pyrex) are more inert and resistant to breakage than soda glass,

the low cost alternative. However, soda glass has a greater tendency to leach inorganic ions in the presence of strong acids or bases than borosilicate glass.

Plastic containers are constructed of high density polyethylene, linear polyethylene, fluorinated ethylene propylene (Teflon), polycarbonate, polypropylene, polyvinyl chloride, and polymethylpentene. Teflon offers the greatest resistance to chemical attack and to breakage of all the plastics. However, its high cost may make its use economically unattractive. The plastic material offering the best combination of chemical resistance and low cost is linear polyethylene.

Sample containers must have tight screw-type lids. Glass containers must be supplied with rigid plastic screw caps with Teflon lid liners. Usually, plastic containers are supplied with screw caps fabricated from the same material as the container. Cap liners are usually not required for plastics.

Glass or Teflon containers are recommended when samples are to be assayed for organic constitutents. Plastics are recommended when the analysis is for inorganic parameters.

During the field program at RMA, building and sewage sludges samples to be assayed for organic analytes will be collected, stored, and shipped to the laboratories in five ounce wide-mouth amber borosilicate glass bottles with Teflon lined screwcaps lids. Building and sewage sludge samples for inorganic analytes will be collected, stored and shipped to the laboratory in plastic bottles. Soil boring samples will be stored and shipped in foot long sections of the polybutyrate core casings unless otherwise specified in this sampling plan. These core casings will be Teflon capped upon removal from the sampling rig.

Liquid samples, except those for volatile organics, will be filtered through a 0.45 ft. filter to remove particulate matter in the field. Samples for metals analyses must be filtered in the field prior to preservation. Samples of liquids for organic analyses will be placed in amber glass bottles. Liquid samples for inorganic analytes will be placed in plastic

bottles. Samples of liquids for metals analyses will be acidified with nitric acid to a pH <2 before shipment.

10.3 Sample Identification

Accurate sample identification will be required to document a sample from the point of its collection through the reporting of the associated analytical results. When in situ measurements are made, this data will be recorded directly into a bound Field Data Logbook (FDL). Field observations will also be recorded in the FDL.

Sample identification will be by a project specific sample code. Assignment of a unique sample code to a specific sample will be the responsibility of the on-site sampling team coordinator. The sampling team leaders, by direction of the on-site sampling team coordinator, will ensure that each physical sample, all photographs of the sample site, and all data recorded in the FDL are labeled with a unique sample identification for that specific sample. The physical sample will be identified by attaching a sample tag to the sample container (Figure 10-1).

The on-site sampling team coordinator will control the distribution of sample tags. Each tag will be sequentially numbered with a unique serial number, a hyphen, and the project code. The unique serial number will begin with the letter N followed by four numbers, 0001 through 9999. The project code will be a three digit number identifying the specific RMA task (e.g., 002 for task 2, 005 for task 5, etc.). Sample tag numbers and the project code will be placed in the lower right hand corner in the remarks section. Each sample tag must be accounted for at the end of the project. The on-site sampling team coordinator is accountable for each sample tag assigned to a sampling team. Missing sample tags must be documented by a memo to the project coordinator describing the fate of the tag.

Information that is recorded on the sample tag and in the FDL was selected to meet USATHAMA requirements (Installation Restoration Data Management Users Guide - Version 84.1, section 4.1R* Dictionary Elements by File Type [January 3, 1985]) and the NEIC (EPA-330/9-78-001R). This sample

ANALYSES		Site Type	Site Identification	
% Moisture				
Organics Screen/ Air – Charcoal/Tenax		Date	Time	Sample Depth
Volatile Organics Screen Purge – Trap, GC/MS		Sample Tech.		
Semi-Volatile Organics Screen Capillary GC/MS				
Metals Screen, ICP		Samplers (Signatures)		
Mercury Cold Vapor AA				
DBCP, GC/EC				
		Remarks:		
Preservative: Yes ☐ No ☐				

EBASCO SERVICES INCORPORATED
1617 COLE BOULEVARD
GOLDEN, COLORADO 80401

ENVIRONMENTAL PROGRAM AT
ROCKY MOUNTAIN ARSENAL

Figure 10-1 The Sample Tag

information must also have a matching record in the RMA map file that precisely defines the sample point. Except for quality control samples, all samples recorded on a sample tag and FDL must have a matching record in the RMA map file that defines the location of the sample point. The map file will associate grid coordinates with each sample point. The information recorded on the sample tag and in the FDL includes the following:

- Site type - a two to four letter abbreviation identifying type of landmark, feature or construction being sampled. This abbreviation must match one of the USATHAMA acceptable codes identified for chemical data.

  Air Samples:
  - ARMD - Air monitoring station
  - CSDT - Chemical sludge disposal trenches
  - CMPH - Composite sample taken from multiple locations
  - OLSP - Old lagoon sludge pile

  Building Survey Samples:
  - BATT - Battery
  - BLDG - Building
  - CASE - Casement
  - CMPH - Composite sample taken from multiple locations

  Groundwater Samples:
  - CMPH - Composite samples taken from multiple locations
  - DRWM - Drilling water source
  - FLPH - Floodplain
  - LYSM - Lysimeter
  - SPRG - Spring
  - WELD - Dry well - old fashion type well
  - WELL - Completed well

  Sediment Samples:
  - BASN - Basin
  - BAYU - Bayou

BORE - Bore hole
CMPH - Composite sample taken from multiple locations
CREK - Creek
DTCH - Ditch or drainage
FLPL - Floodplain
IWTP - Industrial waste treatment plant
LAFL - Landfill
LAGO - Lagoon
LAKE - Lake
MAHO - Manhole
PLUG - Shovel sample
POND - Pond
PRSW - Process sewer
RSVR - Reservoir
RVER - River
SKHL - Sink hole
SPRG - Spring
STP - Sanitary treatment plant
STRM - Stream
SURF - Surfaces in general
SWER - Sewer
WELD - Dry well, old fashion type well

Soil Samples:

AREA - Area of land
BASN - Basin
BLDG - Building
BORE - Bore hole
BUGR - Burning ground
CD - Coniferous-deciduous woodland
CMPH - Composite sample taken from multipe locations
CREK - Creek
CSDT - Chemical sludge disposal trenches
DEMO - Demolition area
DTCH - Ditch or drainage
DW - Deciduous woodland

FELD - Field
FLPL - Floodplain
LAFL - Landfill
LAGO - Lagoon
PIT - Pit/tree spade
PLUG - Shovel sample
OLSP - Old lagoon sludge pile
SKHL - Sink hole
SUMP - Sump
TRST - Tree stand
WASS - Solid Waste
WT - Weedy type

Sewer Samples:

CMPH - Composite sample taken from multiple locations
MAHO - Manhole
SASW - Sanitary sewer
STP - Sanitary treatment plant
SWER - Sewer

Surface Water Samples:

BASN - Basin
BAYU - Bayou
CMPH - Composite sample taken from multiple locations
CREK - Creek
DAM - Dam
DTCH - Ditch or drainage
LAFL - Landfill
LAGO - Lagoon
LAKE - Lake
MT - Marshy type
POND - Pond
RSVR - Reservoir
RVER - River
SKHL - Sink hole
SPRG - Spring

STP - Sanitary treatment plant
STRM - Stream
STSW - Storm sewer
STWA - Standing water
SUMP - Sump
SWER - Sewer
TAPW - Tap water source

Quality Control Sample Records:
QCBL - QC Blank
QCFB - QC Field Blank
QCMB - QC Method Blank
QCSP - QC Spike

Unexploded Ordnance:
CNTC - Contact point

- Site Identification - a left justified alphanumeric identifier with up to ten characters. The site ID for samples at RMA will begin with a single letter code to identify the type of sample taken. Each single letter character will be followed by a three digit sample number ranging from 001 to 999 to sequentially number each borehole or building in a series.

  For example, the assigned single letter codes for Task 2 samples are as follows:

  A - Phase IA building and soil samples
  B - Phase IB building samples
  C - Phase IB sewer samples
  D - Phase IB sump, tank and vat samples
  E - Phase IB soils from historic sites
  F - Phase IB soils from spill sites
  G - Phase IB soils from the vicinity of sewer lines
  H - Phase II soils from historic sites
  I - Phase II soils from spill sites
  J - Phase II soils from sewer lines

Assigned single letter codes for Task 7 samples are as follows:

K - Uncontaminated areas of Sections 1 and 2
L - Nemagon spill sites in Sections 3, 4 and 33
M - Sewage treatment plant in Section 24
N - Solid waste disposal area in Section 30

Following the sample number, constructed sites will be identified by the three or four character numeric or alpha numeric identifier for that structure. Soil samples will be identified by a five character alpha numeric unique to each bore hole. Quality control samples will use the first for alpha numeric characters of the site ID followed by a six digit number identifying the spike concentration.

- Date - a five digit number indicating the year and day of the year that corresponds to the Julian calendar date. Table 10-1 defines the Julian day for nonleap year Gregorian dates. The Julian day for the corresponding nonleap year Gregorian date can be located at the intersection of the month row and day column. For example, the Julian date for March 18, 1985 is 85077.

- Time - a four digit number indicating the 24-hour military standard time of collection. For example, 9:30 AM is 0930 and 2:30 PM is 1430.

- Sample depth - a six digit number to designate the depth from land surface to top of sample taken. For buildings taken above the land surface use a minus sign (-) and five digits to express sample height above the land surface. All measurements must be reported in centimeters.

- Sample techniques - a one character letter or number used to differentiate sampling techniques. Acceptable entries are as follows:

TABLE 10-1

JULIAN DAYS FOR NON-LEAP YEAR GREGORIAN CALENDAR DATES

GREGORIAN CALENDAR DATES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
JANUARY	001	002	003	004	005	006	007	008	009	010	011	012	013	014	015	016	017	018	019	020	021	022	023	024	025	026	027	028	029	030	031
FEBRUARY	032	033	034	035	036	037	038	039	040	041	042	043	044	045	046	047	048	049	050	051	052	053	054	055	056	057	058	059	/	/	/
MARCH	060	061	062	063	064	065	066	067	068	069	070	071	072	073	074	075	076	077	078	079	080	081	082	083	084	085	086	087	088	089	090
APRIL	091	092	093	094	095	096	097	098	099	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	/
MAY	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151
JUNE	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	/
JULY	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212
AUGUST	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243
SEPTEMBER	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	/
OCTOBER	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304
NOVEMBER	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	/
DECEMBER	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365

A Clamshell
B Bail
C Composite grab
D Dredge
E Ekman grab
F Fifteen centimeter plugs
G Single grab
H High volume sample
I Van Doren bottle for surface water samples
J Cotton swabs
K Air filter
L Lysimeter
M Tensiomneter
N Surface wipe heavy metals
O Solvent wipe/extract
P Pump
Q Portable HG
R Direct reading-radiological probe
S Split spoon core sample
T Shelby tube core sampling
U Soil Auger
V Visual discriminator-reagent spray
W Surface wipe radiological
X Composite core sample
Y Spot spray test
Z Scraping from physical surface
1 Magnetometer (UXO survey)
2 Well sampler
3 Certification packet (Certipak)
9 Unknown (use only when authorized by THAMA)

The sample tag also contains an appropriate section to indicate the analytical requirements for each sample and whether sample preservative is required. The sampler signs each sample tag and completes the form by recording his or her remarks, if any. When used for air samples, the sampler may use the remarks section to designate the sampling times and

collection medium. The sample tags should be attached to each sample container by the sampler prior to sampling. After collection, the sample is maintained under the chain of custody procedures.

10.4 Chain of Custody Record

To maintain and document sample possession, chain of custody procedures are required. These procedures are necessary to insure the integrity of samples from collection to data reporting. Chain of custody provides the ability to trace possession and handling of samples from the time of collection through analysis and data deposition.

Chain of custody is mandatory when there is any possibility that analytical data and conclusions based on analytical data may be used in litigation. In projects that do not involve litigation, these procedures are still useful for routine control of samples.

A sample is considered under custody if:

- It is in your possession or
- it is in your view after being in your possession or
- it was in your possession and you locked it up or
- it is in a designated secure area.

The sampler who has samples under custody is personally responsible for the care and integrity of these collected samples until they are properly transferred or dispatched. Therefore, the number of people handling a sample should be kept to a minimum.

Sample tags will be completed as described in section 10.3 for each sample using waterproof ink. If waterproof ink cannot be used, a signed entry will be made in the FDL to document specific conditions prohibiting its use.

The chain of custody records will be sequentially numbered and assigned by the on-site sampling team coordinator to each sampling team. The on-site sampling team coordinator is responsible to the project manager for each

chain of custody record issued. Missing chain of custody records must be documented.

A chain of custody record form is completed by the sampler in the presence of the on-site sampling team coordinator (See Appendix B). The sampler will sign the form where indicated and record site type, site identification, sample data, time, sample depth, and sample techniques for each sample collected. The on-site sampling team coordinator will instruct the sampler on what analyses are required for each sample. The sampler will check off each sample analysis required on the chain of custody form and check the sample tag and chain of custody record for accuracy and completeness. The project manager, or a designated field representative, will determine whether proper custody procedures were followed during field work. Improper chain of custody procedures may require that samples be taken again. Only when the chain of custody has been verified, may the sampler relinquish custody of the samples.

10.5 Transfer of Custody and Sample Shipment

When transferring custody of samples, the individuals relinquishing custody and receiving custody will sign, date, and record the time on the chain of custody record. The chain of custody record form documents the transfer of samples from the sampler to the analytical laboratory.

The following procedure will be followed to transfer a sample from the contamination area to the support zone. The sampler will relinquish custody of samples to the sample coordinator for packaging and shipment. This transfer will occur in the Contamination Reduction Zone in the vicinity of the decontamination trailer.

The sample coordinator will hold open a ziplock plastic bag. The sampler will place the sample bottle into the bag and the sample coordinator will close the bag seal. The bagged sample will be placed in a telescoping sample tube. The sample coordinator will sign a sample tamper seal indicating the date, time, and place collected (Figure 10-2). For sample containers, the sample number will be the alphanumeric site identification.

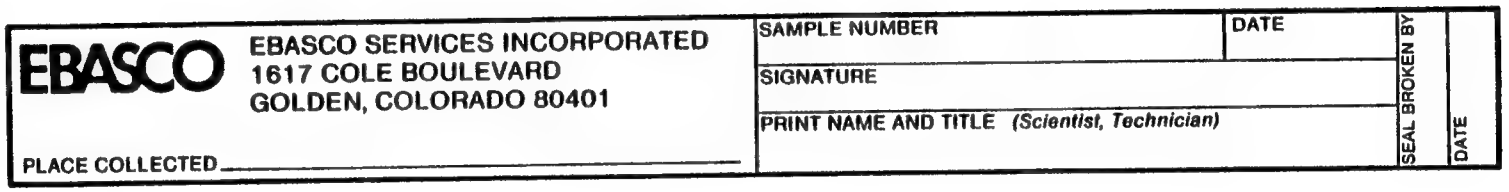

Figure 10-2 The Sample Tamper Seal

The tamper seal must be attached to the sample tube in such a way that it will break when the container is opened. Sealed sample containers will be placed in a plastic ice chest with packages of frozen blue ice and tightly packed with suitable packing material.

After closure, the ice chest will be sealed with a tamper tag. The sample coordinator will fill out the ice chest tamper tag as described above. However, this time the place collected will be identified as Rocky Mountain Arsenal. The seal will be attached to the ice chest in such a way that it is necessary to break it to open the ice chest.

All tamper tags must be applied to sample containers and ice chests in the presence of the samplers and on-site sampling team coordinator. The ice chest will be taped closed by wrapping each end at least twice with either fiberglass reinforced tape or a strong adhesive tape. Don't use paper tape or "Scotch" tape.

A hazardous substance notification label is to be prominently affixed on the ice chest (Figure 10-3). The sample coordinator should indicate that the hazardous substance in the container is either a solid or liquid by crossing out the inappropriate term with a black felt tip pen. The ice chest is to be weighed, and a completed Federal Express Restricted Articles Shipment form attached to each ice chest to be shipped. The packed weight of each ice chest must not exceed 150 pounds. An example of a properly completed Federal Express Restricted Articles Shipment form is shown in appendix B.

Additional information regarding shipment of hazardous materials may be obtained from the Federal Express Restricted Articles Information Extension. Their telephone number is: 1-(800) 238-5355.

Shipped samples must be accompanied by the chain of custody record. The sample coordinator will make two copies of the record. One copy is to be placed in the field files, and the other copy of the record will be delivered to the owner, operator, or agent in charge of the site as a receipt describing the samples obtained (i.e., the Army or Shell).

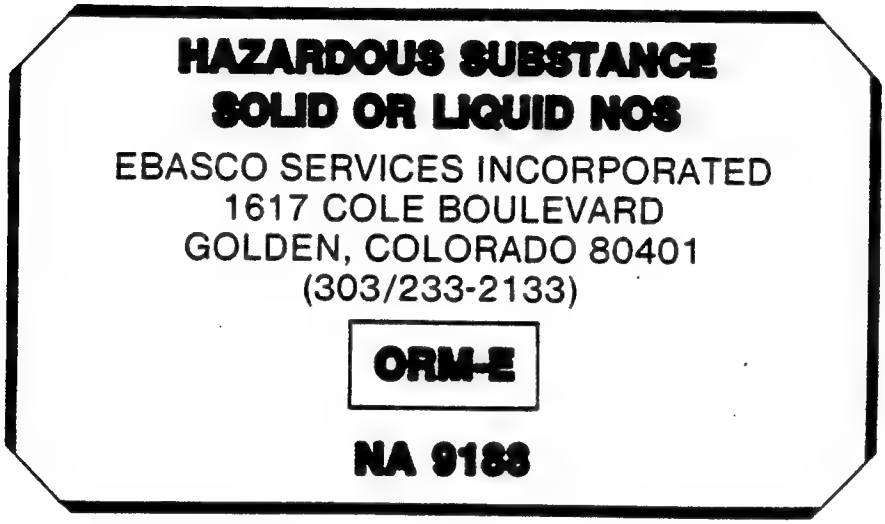

Figure 10-3 Hazardous Substance Notification Label

Under section 3007(a)(2) of the Resource Conservation and Recovery Act (RCRA) and section 104 of the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), the owner, operator, or agent in charge of the site may also request a portion of each sample equal in volume or weight to the portion retained. If such a request is made, the laboratory will prepare sample splits and note the sample split date on the chain of custody record. Sample splits will be shipped from the laboratory to the indicated address under chain of custody. The chain of custody record will be the only receipt for samples provided.

The original chain of custody record will be signed, dated, and the time recorded by the sample coordinator prior to transferring custody for shipment. A notation will be made in the remarks section of the record indicating method of shipment, courier's name, and other pertinent information. The chain of custody record will be sealed in an envelope and taped to the inside of the ice chest with the name and address of the receiving laboratory prominently displayed. The sample coordinator will deliver the sample shipment to the courier. After custody of the shipment is relinquished to the courier, the sample coordinator must witness the sample being secured in the courier's vehicle and driven from the site before his responsibility for the samples ends. Alternatively the ice chest may be taken directly to the airport by the sample coordinator and custody relinquished to the shipping agent.

Upon receipt of shipment at the laboratory, a designated sample custodian accepts custody of the samples and verifies that information on the sample tags matches the chain of custody record. Pertinent information as to shipment, pickup, courier, date, and time will be recorded on the record. A copy of the courier's Retricted Articles Shipment form will be attached to the chain of custody record to document the shipment.

11.0 LABORATORY LOGGING AND DISTRIBUTION OF SAMPLES

11.1 Introduction

The purpose of this document is to outline in detail the responsibilities of the laboratories in the RMA contamination assessment program.

11.2 Sample Container Preparation (UBTL)

The purpose of this activity is to cost-effectively procure appropriate sample containers, clean them as specified in the project QA plan, and deliver the necessary containers to the Denver office of Ebasco for field sampling.

1. Descriptions, sources and cleaning procedures for all sample containers are summarized in Table 11-1.

2. Containers for field use will be shipped UPS to Denver.

3. Containers for laboratory splits will be held at UBTL.

11.3 Sample Receipt (UBTL)

The objectives of this section are to ensure proper chain of custody and verify sample intergrity.

1. The shipping chests are opened by a designated sample receipt officer.

2. The chain of custody sheets are signed by the sample receipt officer.

3. The samples are recorded in the laboratory receiving notebook according to section 10.2 of the Project QA plan (Appendix E of the RMA Technical Plan).

4. In the event that any questionable circumstances are noted (broken or damaged samples, missing samples, chest contents too warm, broken chest

TABLE 1.

SUMMARY OF SAMPLE CONTAINERS FOR RMA FIELD USE AND LABORATORY SPLITS

Containers for Field Use Analysis/Matrix	Container	Cleaning Protocol	Source	Amount of Material	No. of Containers
Semi. Vol. Org./Solids	5 oz. Amber Glass 45 mm Metal Lid Teflon Liner Cut From Sheet Teflon	QA-8.2.2.1 QA-8.2.2.4 QA-8.2.2.5	Industrial Container Supply, SLC, UT, Part #GG Industrial Container Supply, SLC, UT, Part #L018 Berghof, Inc.	At least 15 gm	200
ICP Metals/Solids	6 oz. Polypropylene 45 mm Polypropylene Lid	QA-8.2.2.3 QA-8.2.2.3	Industrial Container Supply, SLC, UT, Part #J044 Industrial Container Supply, SLC, UT, Part #L238	At Least 1 gm	200
Asbestos/Bulk	20 mL Polyethylene Scinti-vial with Polypropylene Lid	Use as received	American Scientific Products, Wheaton #986724	At Least 1/2 Full	150

Containers for Laboratory Splits Analysis/Matrix	Container	Cleaning Protocol	Source	Amount of Material	No. of Containers
Vol. Org. Screen/Solids	40 mL Amber Glass VOA Vial Teflon-Lined Screw Cap, 24-400	QA-8.2.2.2 See Note 1	Pierce, Part #13090 Qorpack, Part #2035205	10 g (weighed)	1000
Semi. Vol. Org./Solids	5 oz. Amber Glass 45 mm Metal Lid Teflon Liner Cut From Sheet Teflon	QA-8.2.2.1 QA-8.2.2.4 QA-8.2.2.5	Industrial Container Supply, SLC, UT, Part #GG Industrial Container Supply, SLC, UT, Part #L018 Berghof, Inc.	50 g (approx)	1000
ICP Metals/Solids	20 mL Polyethylene Scinti-Vial with Polypropylene Lid	QA-8.2.2.3 QA-8.2.2.3	Wheaton, Part #986724	10 g (approx)	500
Mercury/Solids	20 mL Polyethylene Scinti-Vial with Polypropylene Lid	QA-8.2.2.3 QA8.2.2.3	Wheaton, Part #986724	10 g (approx)	500
DBCP/Solids	40 mL Amber Glass VOA Vial Teflon-Lined Screw Cap, 24,400	QA-8.2.2.2 See Note 1	Pierce, Part #13909 Qorpak, Part #2035205	10 g (weighed)	700
TOC/Solids	40 mL Amber Glass VOA Vial Teflon-Lined Screw Cap, 24,400	QA-8.2.2.2 See Note 1	Pierce, Part #13909 Qorpak, Part #2035205	10 g (approx)	5
Moisture	Dried, Tared Container	--	--	10 g. (weighed)	1000
Extra sample storage for organic backup	5 oz. Amber Glass 45 mm Metal Lid Teflon Liner Cut from Sheet Teflon	QA-8.2.2.1 QA-8.2.2.4 QA-8.2.2.5	Industrial Container Supply, SLC, UT, Part #GG Industrial Container Supply, SLC, UT, Part #L018 Berghof, Inc.	Full	1000

Note 1: This is phenolic cap with polyethylene film/foam backed Teflon liner. It is cleaned by shaking the appropriate extracting solvent in a capped vial, removing the cap and air drying. Methanol is used for Volatile Organics Vials, Hexane/Acetone for DBCP vials and Methanol for TOC vials.

seal) they are recorded in the receiving notebook and the field coordinator is notified immediately by telephone.

11.4 Soil Sample Removal and Splitting (UBTL)

The objective of the following procedures is to provide splits of soil samples for the required laboratory analyses while minimizing loss of analytes and cross contamination.

1. The central portion of soil in the plastic tube will be taken for analysis. No soil which has been within approximately one-half inch of the walls or end caps will be used for analysis.

2. All implements which contact the soil will be made of aluminum or steel. (Aluminum and iron are present at high levels in the soil background.)

3. The portion to be used for analysis will be collected on the dull side of aluminmum foil and gently mixed. Extensive mixing will be avoided in order to retain the volatile organics.

4. The sample for volatile organics will be collected first, followed by the samples for semivolatile organics and DBCP. Samples for metals, mercury, and moisture are collected last. Sufficient back-up soil for inorganic analytes will be included in the containers. An additional container of backup soil for the organic analyses will be collected. All remaining soil will be returned to the plastic tube.

5. Each split will be placed in a bottle labeled with the analysis and the field number. Those samples which will be processed in the split containers will have the weight recorded on the container as well (volatile organics and DBCP).

6. The moisture test will be started as soon as possible.

7. Weighings will be performed to $\pm$ 0.1 g using a top-loading balance.

8. The date of splitting will be written on the chain of custody sheet.

9. Each group of split samples for a particular analysis will be accomplished by a copy of the chain of custody sheet with the desired analysis conspicuously identified.

11.5 Sampling Lotting (UBTL)

The purpose of lotting is to assign laboratory numbers and to group field samples and QC samples together in lots of appropriate size for analysis in one day. The procedures are as follows:

1. Lotting will be performed under the direction of the UBTL Field Quality Assurance Coordinator (FQAC).

2. Samples will be grouped to form a lot and the three-letter, three-digit laboratory number labels are placed on the vials. Laboratory numbers are reserved for QC samples. However, the QC samples are actually prepared by the responsible laboratory shortly before analysis. Lot sizes and number of QC samples are summarized in Table 11-2.

3. Each lot will have a paperwork package which consists of the following items:

   a. A copy of the chain of custody sheet(s) with the desired test conspicuously identified. This is the tracking sheet.

   b. A copy of the chain of custody sheet(s) with the % moisture reported for each field number.

   c. A coding form for reporting data with the sample date, site type, site ID, sample depth, sample number, test name and method code filled in. "Extract by (date)" and "analyze by (date)" will be noted on the top of the coding form.

TABLE 11-2

ANALYTICAL LOT REQUIREMENTS

Analysis	Number of QC Spikes	Method Blank	Number of Splits	Minimum Lot Size	Maximum Lot Size
Vol. Org./Solids	- 0 -	1	- 0 -	8	8
Semi Vol. Org/Solids	- 0 -	1	- 0 -	8	8
ICP Metals/Solids	3	1	1	10	20
Arsenic/Solids	3	1	1	10	20
Mercury/Solids	3	1	1	10	20
DBCP/Solids	3	1	1	10	25

Note: The air/Tenax, air/charcoal, TOC, Moisture, and Asbestos analyses are not certified.

11.6 Laboratory Sampling Shipping (UBTL)

The purpose of the sample shipping procedures described below is to provide for the rapid transport of samples from UBTL to other laboratories such that sample integrity is maintained, proper temperature is maintained, and chain of custody is maintained. The procedures are as follows:

1. Samples for ICP arsenic and mercury anaylsis will be place in plastic bags for shipping in sample chests.

2. Samples in 40 mL amber glass vials (Vol. Organics and DBCP) will be wrapped in a shock absorbing material and place in individual zip-lock bags for shipping in the chest.

3. Samples for semi-volatile organics and containers of backup soil will be packed with suitable packing material in cardboard sleeves of the same type used to ship the plastic tubes.

4. The paperwork package for each lot, which includes a chain of custody sheet for the lot, will be placed in a zip-lock plastic bag in the chest.

5. Sufficient bags of ice or blue ice will be placed in the chest for cooling.

6. The chest will be sealed with a chain of custody seal and sent out air express for next-day delivery.

7. Each sample shipment will be recorded in a logbook which includes the following information:

   a. The USATHAMA project identification (RMA2)
   b. Date of shipment
   c. Carrier
   d. Sample field numbers and laboratory numbers

11.7 Chemical Analysis (All Laboratories)

The following extractions and analyses of solids are performed according to USATHAMA certified methods:

Volatile Organic Screen by GC/MS
Semi-volatile Organic Screen by GC/MS
Metals Screen by ICP
Arsenic by AA
Mercury by CV/AA
DBCP by CG/EC

The analysis of other samples are performed using methods which are not USATHAMA certified; however these methods are EPA or NIOSH certified. These methods are:

Air/Tenax by GC/MS
Air/Charcoal by GC/MS
Organic Matter in Soils (Dichromate Oxidation)

Asbestos by Polarized Light Microscopy
Moisture by Weight

11.8 Data Reporting

The objective of this procedure is to produce analytical data in a form suitable for entry into Level 1 of the USATHAMA IR-DMS data management system. The procedures are as follows:

1. Analytical data are calculated according to the specified method and corrected for moisture and recovery (supplied by field laboratory quality assurance coordinator based upon the most recent results of the accuracy control charts).

NOTE

QC samples are not corrected for moisture or recovery.

2. The analysis date, analytical result, and initials of the analyst are entered onto the coding form.

3. The calculations and transcriptions are verified by another analyst who initials and dates the top of the coding form.

11.9 Laboratory QA Review

The purpose of this review is to establish the quality of the reported data before releasing it for entry into Level 1 of the IR-DMS data management system. The procedures are as follows:

1. The results of the analysis of the spiked QC samples are compared with the accuracy and precision limits derived from current control charts.

2. If the spiked QC results are in control, the coding form is checked for completeness and the data set is released for entry into Level 1 of the IR-DMS data management system. The QC results are used to update the accuracy and precision control charts.

3. If the spiked QC results are not acceptable, the corrective measures, outlined in the project QA Plan section 12.7 Appendix E of the RMA Technical Plan, are implemented.

11.10 Data Transmittal

The complete coding forms are mailed to Envirosphere's Denver office for data entry via the Tektronix terminal.

11.11 Weekly Laboratory Reports

The purpose of weekly laboratory reports is to provide timely information regarding the status of the laboratory effort.

1. Each laboratory will submit a weekly Quality Assurance Program Status Report. This report will be provided within four days after end of each week during which chemical analyses are performed in the laboratory. The report will contain:

   a. Current precision and accuracy charts for all analyses.

   b. Quality problems encountered that could affect performance and/or delivery of contract items and corrective actions.

   c. Deviations from the government accepted QA Program Plans and contemplated revisions.

2. Each laboratory will submit a weekly sample status report as soon as possible after the end of the week to aid in planning the rate of field sampling and the distribution of laboratory workloads. The report will contain the following items. Lot code (three letters only), analysis, number of samples, sampling date, extraction date, and analysis date. When the results for a lot are mailed out, that lot will be deleted from the weekly sample status report.

12.0 SITE IMPLEMENTATION PLANS (SIPs)

12.1 Introduction

The Site Implementation Plan is an informational summary sheet (Figure 12.1-1). This sheet will be reviewed by sampling personnel prior to any building entry. After sampling, it will be updated by the on-site sampling team leader and the health and safety coordinator. It will be filed as part of the permanent record for that building. It will be used to summarize important points from the building profiles. Completion of the SIP is viewed as an important step in the sampling program.

In addition to reviewing the SIPs and building profiles, a daily field activity checklist must be completed (figure 12.1-2). This is to assure that routine tasks, essential for daily project continuity, are done on a daily basis. Keeping the daily field activity checklist is the responsibility of the on-site sampling team coordinator. The completed form is filed as part of permanent project records.

EBASCO/ENVIROSPHERE

SITE IMPLEMENTATION PLAN

Building: _____ Date of Phase IA Sampling:_____

Health and Safety Considerations:

QA/QC Considerations:

Type of Samples to be Taken:

Proposed Equipment List:

Special Sampling Considerations:

Phase IB Sample Locations to be Checked During Phase IA:

Figure 12.1-1 Site Implementation Plan

EBASCO/ENVIROSPHERE

DAILY FIELD ACTIVITY CHECKLIST

Date: _____ This Report Filed By _____

MORNING ACTIVITIES

1. Ebaasco health and safety coordinator has done the following tasks:

   No: ___ Yes: ___ Placed work location pins in map at the fire station.

   No: ___ Yes: ___ Filled out daily field work plan.

   No: ___ Yes: ___ Left copy of daily field work plan with Army fireman on duty this morning.

   No: ___ Yes: ___ Gave daily safety briefing to Ebasco personnel.

   No: ___ Yes: ___ Recorded content of daily safety briefing and attendees in health and safety notebook.

2. The following tasks were done (must be done prior to sampling):

   No: ___ Yes: ___ SIPs completed for buildings to be sampled today.

   No: ___ Yes: ___ Building field sampling data sheets completed.

   No: ___ Yes: ___ Soils field sampling data sheets completed.

   No: ___ Yes: ___ Sample tags completed.

AFTERNOON ACTIVITIES

1. The following tasks were done (must be done before leaving the site):

   No: ___ Yes: ___ Chain of custody record filed for each sample.

   No: ___ Yes: ___ Field log of boring completed.

   No: ___ Yes: ___ Field data logbook up-to-date.

Figure 12.1-2 Daily Field Activity Checklist

APPENDIX A

DAILY SAFETY BRIEFING OUTLINE

Daily Safety Briefing

I. Review Facility/Site Information

A) Facility ID and Location

B) Facility Layout
   1. Establish entry/exit point(s)
   2. Identify potentially hazardous areas
   3. Discuss physical condition of facility
   4. Potential location of utilities

C) Facility Usage
   1. Most recent
   2. Historic

D) Identify Suspected Contaminants and Warning Their Properties

E) Establish Site Zones and Layout of Support Facilities

II. Review Planned Activities

A) Purpose of Entry
B) Personnel Authorized Downrange
C) Team Members and Their Responsibilities
D) Sequence of Entry

III. Establish Personnel Protection

A) General Levels of Protection
B) Respiratory Protection
C) Protective Clothing
D) Preemptive Measures to Reduce Stressful Conditions

IV. Review Decon Procedures

A) Personnel Decon Procedures
B) Sampling Equipment/Materials Decon
C) Other Equipment Decon
D) Location of Decon Equipment and Supplies
E) Disposal of Contaminated Expendables
F) Site Policing

V. Identify Available Safety Equipment

A) Type of Equipment
B) Location of Equipment
C) Use of Equipment
D) Special/Operation Specific Equipment

VI. Identify Contingency Planning

A) Daily Notification of RMA Emergency and Other Services of Work Location and Activities
B) Location of Emergency Communications
C) Evacuation
    1. Routes
    2. Safe locations
D) Emergency Signals
E) Emergency Procedures
    1. Emergency decon
    2. Fire/explosion
    3. Discovery of UXO
    4. Injury
    5. Contamination
    6. Adverse weather
F) Location of Emergency Information
G) Support Team

VII. Describe Communications

- A) Line of Sight/Buddy System
- B) Radio
- C) Telephone
  1. RMA fire phones
  2. Command post phone
- D) Air Horn/Vehicle Horn
- E) Hand Signals
- F) Specific Emergency Signals

VIII. Identify Monitoring

- A) Types of Instruments
- B) Alarms
- C) Weather Monitoring
- D) Heat/Cold Stress

IX. Review Prohibited Activities

APPENDIX B

STANDARD FORMS

EBASCO SERVICES INCORPORATED
ENVIRONMENTAL PROGRAM AT ROCKY MOUNTAIN ARSENAL

HAZARDOUS WASTES/GROUND-WATER CONTAMINATION STUDIES
SOLIDS/SOIL BORING QUALITY FIELD SAMPLING DATA SHEET

PROJECT _____ BORING NO. _____ DATE _____ TIME _____

DRILLERS _____

SAMPLERS _____

SUPERVISOR _____

BORING DEPTH (TOTAL) _____

WATER LEVEL _____

SAMPLED INTERVAL	SLEEVE IDENT.	SAMPLE IDENT.

SAFETY PROCEDURES (TO BE COMPLETED BY SAFETY OFFICER)

SIGNATURE OF
SAFETY OFFICER

NO. OF SAMPLES RELINQUISHED _____ TO _____ DATE _____

FIELD EQUIPMENT

O.V.A. METER _____ SERIAL NO. _____

HAND AUGER _____ SERIAL NO. _____

RIG _____

ANALYSES		
METALS SCREEN, ICP		
MERCURY COLD VAPOR AA		
VOLATILE ORGANICS GC/MS		
SEMI-VOLATILE ORGANICS GC/MS		
DBCP, GC/EC		
% MOISTURE		

EBASCO SERVICES INCORPORATED
ENVIRONMENTAL PROGRAM AT ROCKY MOUNTAIN ARSENAL

HAZARDOUS WASTES/GROUND-WATER CONTAMINATION STUDIES
BUILDING/SOLIDS QUALITY FIELD SAMPLING DATA SHEET

PROJECT _____ BUILDING NO. _____ DATE _____ TIME _____

AIR SAMPLING TECH. _____

SAMPLERS _____

SUPERVISOR _____

STRUCTURAL ENGINEER _____

PROCESS ENGINEER _____

REMARKS _____

SAFETY PROCEDURES (TO BE COMPLETED BY SAFETY OFFICER)

SIGNATURE OF
SAFETY OFFICER _____

NO. OF SAMPLES RELINQUISHED _____ TO _____ DATE _____

FIELD EQUIPMENT

O.V.A. METER _____ SERIAL NO. _____

H Nu METER _____ SERIAL NO. _____

COMBUSTIBLE GAS METER _____ SERIAL NO. _____

MERCURY METER _____ SERIAL NO. _____

CHLORINE METER _____ SERIAL NO. _____

PHOSGENE METER _____ SERIAL NO. _____

M-8 METER _____ SERIAL NO. _____

M18A$_2$ METER _____ SERIAL NO. _____

EBASCO SERVICES INCORPORATED
ENVIRONMENTAL PROGRAM AT ROCKY MOUNTAIN ARSENAL

FIELD LOG OF BORING

SITE TYPE	SITE ID
BORE	

SHEET _____ OF _____

PROJECT NAME AND LOCATION	PROJECT NUMBER	ELEVATION AND DATUM	
DRILLING COMPANY	DRILLER	DATE AND TIME STARTED	DATE AND TIME COMPLETED
DRILLING EQUIPMENT: METHOD		COMPLETION DEPTH	TOTAL NO. OF SAMPLES
SIZE AND TYPE OF BIT		NO. OF SAMPLES: BULK / SS	DRIVE / PITCHER
DRILLING FLUID		WATER LEVEL: FIRST	AFTER _____ HOURS
SAMPLER HAMMER TYPE / DRIVING WT. / DROP		HYDROGEOLOGIST/DATE	CHECKED BY/DATE

DEPTH-FEET	SAMPLES: TYPE AND NUMBER	SAMPLES: INTERVAL	SAMPLES: RECOVERY	SAMPLES: BLOW COUNT	DESCRIPTION	USCS SYMBOL	ESTIMATED PERCENT OF: GR	SA	FI	MOISTURE	CONSISTENCY	COLOR	COMMENTS
0													
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													

EBASCO SERVICES INCORPORATED
ENVIRONMENTAL PROGRAM AT ROCKY MOUNTAIN ARSENAL

FIELD LOG OF BORING

SITE TYPE	SITE ID
BORE	

SHEET _____ OF _____

DEPTH-FEET	SAMPLES				DESCRIPTION	USCS SYMBOL	ESTIMATED PERCENT OF			MOISTURE	CONSISTENCY	COLOR	COMMENTS
	TYPE AND NUMBER	INTERVAL	RECOVERY	BLOW COUNT			GR	SA	FI				
5													
6													
7													
8													
9													
0													
1													
2													
3													
4													
5													
6													
7													
8													
9													
0													
1													
2													
3													
4													
5													

EBASCO SERVICES INCORPORATED
ENVIRONMENTAL PROGRAM AT ROCKY MOUNTAIN ARSENAL

CHAIN OF CUSTODY RECORD

EBASCO SERVICES INCORPORATED
1617 COLE BOULEVARD
GOLDEN, COLORADO 80401

Proj. No.	Project Name

SAMPLERS: *(Signature)*

SITE TYPE	SITE IDENTIFICATION	SAMPLE DATE (JULIAN)	TIME (MILITARY STANDARD)	SAMPLE DEPTH (CENTIMETERS)	SAMPLE TECH.	ANALYSIS REQUIRED: % Moisture	Organics Screen/ Air - Charcoal/Tenax	Volatile Organics Screen Purge - Trap GC/MS	Semi-Volatile Organics Screen Capillary GC/MS	Metals Screen, ICP	Mercury Cold Vapor AA	DBCP, GC/EC			NUMBER OF CONTAINERS	REMARKS

Relinquished by: *(Signature)*	Date/Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date/Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date/Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date/Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date/Time	Received for Laboratory by: *(Signature)*	Date/Time		
Relinquished by: *(Signature)*	Date/Time	Received for Laboratory by: *(Signature)*	Date/Time		

SAMPLE SPLIT DATE _____

SAMPLE EXTRACTION DATE _____

SAMPLE ANALYSIS DATE _____